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PARTS LIST SPECIFICATION:

ASSY, SUB, MULTISYNC PCB - REV/F

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ASSY, H.D. COMPACT MULTISYNC PCB - REV/C

ASSY, MULTISYNC PCB - R.D. PANORAMA - N.A. - REV/A

ASSY, MULTISYNC BOARD SET - R.D. RAMA - N.A. - REV/C

ASSY, H.D. COMPACT MULTISYNC PCB - GERMAN - REV/A

ASSY, H.D. COMPACT MULTISYNC PCB - GERMAN - REV/D

ASSY, COMPACT MULTISYNC - R.D. N. AMERICA - REV/E

ASSY, H.D. COMPACT MULTISYNC PCB - BRITISH - REV/A

ASSY, COMPACT MULTISYNC PCB - BRITISH - REV/D

ASSY, STUN RUNNER MULTISYNC PCB - IRELAND - REV/C

ASSY, STUN RUNNER MULTISYNC PCB - REV/D

ASSY, PROGRAMMED MEMORY & LOGIC, MULTISYNC PCB
STEEL TALONS - REV/A

ASSY, STEEL TALONS, MULTISYNC PCB - REV/B

ASSEMBLY, SUB, MULTISYNC PCB - REV/F

SCHEMATIC MULTISYNC PCB - REV/F

68010 Microprocessor Exceptions

4/25/89

the following error messages are used in Self-Test.
(Game Messages are documented separately.)

Some of the following Error Messages are caused by hardware problems. Others may result from software bugs that have heretofore escaped detection.

The English word of the error message is listed first, followed by the German translation in parenthesis.

BUS ERROR

(BUS FEHLER)

A Bus error signal is produced by the hardware when a memory access is not completed in a reasonable amount of time.

At the start of each memory cycle, the Flip-Flop at 100K is set, enabling the counter at 160E. If the memory cycle is not terminated within 8 microseconds by a Data Acknowledge (DTACK), Valid Peripheral Address (VPA), or a RESET, the counter at 190E produces a Bus Error signal.

Most memory accesses run at maximum speed (500 ns) and are hardwired to produce DTACK. However, the GSP, the MSP, and the DUART can cause the 68010 to wait for them by delaying DTACK. A memory access to the DUART is guaranteed to cause a Bus Error when the DUART is not working or if it is missing.

example of a Bus Error is:

| | | | |
|-----------|----------|------|---|
| BUS ERROR | 11111111 | 2222 | R |
| | 33333333 | 4444 | |

'11111111' is the address being accessed when the Bus Error occurred.

'2222' is the data at address '11111111'.

'R' means it was reading address '11111111'.

('W' would mean it was Writing to address '11111111'.)

'33333333' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Bus Error.

'4444' is the Data of address '33333333'

NMI

is an unused hardware input that would cause a 68010 non-maskable interrupt if it were used. If an NMI occurs it is probably a hardware problem associated with the 74LS148 Priority Interrupt Controller at 170H.

An example of an NMI Error is:

NMI 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

ADDRESS ERROR (ADRESS-FEHLER)

An Address Error occurs when the processor attempts to access a word or a long word at an odd address. This is usually the result of a program error.

An example of a Address Error is:

| | | | |
|---------------|----------|------|---|
| ADDRESS ERROR | 11111111 | 2222 | R |
| | 33333333 | 4444 | |

'111111' is the address being accessed when the Address Error occurred.

'2222' is the data at address '11111111'.

R means it was reading address '11111111'.
(W would mean it was Writing to address '11111111'.)

'33333333' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Address Error.

'4444' is the Data of address '33333333'

ILLEGAL INSTRUCTION (FALSCHE ANWEISUNG)

An Illegal Instruction Error occurs when the 68010 encounters the OP Code for an instruction that is not in the 68010 instruction set. This is usually the result of a program error.

An example of a Address Error is:

ILLEGAL INSTRUCTION 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused Error.

ZERO DIVIDE (0-TEILER)

A Zero Divide Error occurs when a Divide Instruction attempts to divide by Zero. This is usually the result of a program error.

An example of a Zero Divide Error is:

ZERO DIVIDE 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

CHK INSTRUCTION (CHK ANWEISUNG)

The Check (CHK) Instruction is a feature of the 68010 that is not used in this product. It would normally be used by the software to indicate a subscript is out of bounds. If one occurs it may mean that a Program ROM is bad.

An example of a CHK Instruction Error is:

CHK INSTRUCTION 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

TRAPV INSTRUCTION (TRAPV ANWEISUNG)

The TRAPV Instruction is a feature of the 68010 that is not used in this product. It is normally used by the program to indicate an arithmetic overflow. If one occurs it may mean that a Program ROM is bad.

An example of a TRAPV Instruction Error is:

CHK INSTRUCTION 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

PRIVILEGE VIOLATION

The PRIVILEGE VIOLATION Error is produced by a feature of the 68010 that is not used in this product. It is normally used by the program to indicate that a program running in User mode has attempted to execute an instruction available only to a program running in Supervisor mode. In this product all programs run in Supervisor mode. If one occurs it may mean that a Program ROM is bad.

An example of a PRIVILEGE VIOLATION Error is:

PRIVILEGE VIOLATION 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

TRACE (SPUR)

TRACE Error is produced by a feature of the 68010 that is not used in this product. If one occurs it may mean that a Program ROM is bad.

An example of a TRACE Error is:

TRACE 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

FORMAT ERROR (FORMAT FEHLER)

The FORMAT Error is produced by a feature of the 68010 that is not used in this product. If one occurs it may mean that a Program ROM is bad.

An example of a FORMAT Error is:

FORMAT ERROR 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

INITIALIZED INT VEC (FALSCH UNTERBRECHUNG)

The UNINITIALIZED INT VEC Error is produced by a feature of the 68010 that is not used in this product. If one occurs it may mean that a Program ROM is bad.

An example of an UNINITIALIZED INT VEC Error is:

UNINITIALIZED INT VEC 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

SPURIOUS INTERRUPT (UNGEWOLLTE UNTERBRECHUNG)

The SPURIOUS INTERRUPT Error is produced by a feature of the 68010 that is not used in this product. If one occurs it may mean that a Program ROM is bad.

An example of a SPURIOUS INTERRUPT Error is:

SPUROUS INTERRUPT 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused Error.

TRAP (FALLE)

A TRAP Error is produced by a feature of the 68010 that is sometimes used during development but which is not used on production versions of the product. If one occurs it may mean that a Program ROM is bad.

An example of a TRAP Error is:

TRAP 11111111

'11111111' is the address of the next instruction (or maybe the second instruction) to be fetched into the cache after the instruction which caused the Error.

=====

ERROR MESSAGES FROM THE GAME PROGRAM

The following is a list of the various run time errors that can occur while the game program is running. These errors can occur during game play and attract mode, as well as in the operator screens, set controls, and disable broken controls items in the self test menu. Included is a description of what the error means and possible causes.

When one of these errors happens, the error message is displayed on the screen, and for some errors the place where the error occurred and the values in the processor registers are also displayed. This information is kept on the screen for 10 seconds or so, after which the watch dog is no longer accessed and the watch dog circuitry resets the game. If you want the game to hang up with the error message on the screen so you can copy the information down, disable the watchdog and the information will stay on the screen until the game is manually reset or powered off.

The number of each type of error that has happened since the error info was last cleared is stored in non-volatile RAM. You can read and clear this error table from the operator screens entry in the self-test menu. If you see a red message "BAD CHECKSUM, DATA MAY BE INVALID", the error table information was never cleared, or the game was powered off during the zero power memory test, or something is wrong with the zero power RAM. Any numbers you see in the table if this message is displayed are suspect, especially if they are very large. Try a zero power RAM test, then clear the errors and let the game run for a while and see what happens.

WATCH DOG RESET

You will never get a message about this error, but it is kept track of in the table in the operator screens.

The watch dog reset count keeps track of the number of times the game program crashed while running, for any reason. Any of the other errors in the table will add to the watch dog error count if the watch dog is enabled, so if you get 6 GSP timeout errors (for example) you should also get at least 6 in the watch dog error count.

Basically any hardware or software problem which happens while the game is running can cause entries in the watch dog error count. In addition, strong power line glitches, or someone resetting the game board while the game is running will also add to the count.

BUSS ERROR

This error means that the 68000 tried to access an address and didn't get the DTACK signal. Problems with the GSP, the MSP, the DUART, or the DTACK circuitry could cause this.

ADDRESS ERROR

This means that the 68000 tried to do a word wide access to an odd address. It is most likely caused by a software bug. The old self test programs (before version 8.6) have a bug that generates an address error sometimes when you run the ADSP memory test and the memory is bad.

ILLEGAL INST ERROR

This means that the 68000 tried to run an instruction that does not exist. This is probably caused by EPROM problems; try checksumming the ROMS.

DIVIDE BY ZERO ERROR

The 68000 tried to divide something by zero. Could be a software bug or EPROM problem; try checksumming the EPROMS.

CHK INST ERROR**TRAP ERROR****PRIV VIOL ERROR**

The 68000 tried to execute an instruction it shouldn't have. Could be a software bug or EPROM problem; try checksumming the EPROMS.

GSP HANDSHAKE ERROR

Something went wrong with communication between the 68000 and the GSP. Try running the GSP tests.

BAD POLY BUF ERROR

An invalid polygon buffer was received from the ADSP. Possible causes are bad object EPROMS on the ADSP board, hardware problems on the ADSP board, and software bugs. Try running the ADSP tests, especially the ADSP EPROM checksum tests.

MSP TIME OUT ERROR

This is caused by the MSP crashing. Try running the MSP tests.

ADSP TIME OUT ERROR

This is caused by the ADSP crashing. Possible causes are bad object EPROMS on the ADSP board, hardware problems on the ADSP board, and software bugs. Try running the ADSP tests, especially the ADSP EPROM checksum tests.

GSP TIME OUT ERROR

This is caused by the GSP crashing. Possible causes are hardware or software problems with the GSP, and hardware or software problems with the ADSP. Try running the GSP tests and the ADSP tests.

GENERIC ERROR

One of a number of software error checks in the game failed. Could be caused by EPROM problems, or possible software bugs. The message displayed on the screen when the generic error happens will give a clue to what is wrong.

NMI ERROR

A non-maskable interrupt was received by the 68000.
This is almost certainly caused by problems with the interrupt circuitry on the 68000, since this interrupt is not used.

SPUR EXPTN ERROR

An unknown exception was received by the 68000.
Check the EPROM checksums.

ILLEGAL ERROR CODE

There was an invalid code passed to the error function.
Possible software bug, try checking the EPROM checksums.

/ROMEN: Program ROM {Read Only}

| | | |
|-------------------|-------|---|
| 00 0000 - 01 FFFF | ROM 0 | 128K Bytes - SELF TEST (DOWNLOADER @ 10000) |
| 02 0000 - 03 FFFF | ROM 1 | 128K Bytes |
| 04 0000 - 05 FFFF | ROM 2 | 128K Bytes } PROGRAM-DRIVE |
| 06 0000 - 07 FFFF | ROM 3 | 128K Bytes PICS |
| 08 0000 - 09 FFFF | ROM 4 | 128K Bytes |
| 0A 0000 - 0B FFFF | ROM 5 | 128K Bytes UNIV |
| 0C 0000 - 0D FFFF | ROM 6 | 128K Bytes LSP |
| 0E 0000 - 0E 7FFF | ROM 7 | 128K Bytes through Slapstik |

/NBUS Naked Bus

60 0000 {R/W} SCOM IC

60 4000 {R} Reset SCOM IC (Address Strobe)

60 4000 {W} Latches on Address Strobe (Data is ignored)

60 4000 LED 1 off

60 4002 LED 2 off

60 4004 LC1OFF * Aux Control 1 Low (Latched)

60 4006 LC2OFF * Aux Control 2 Low (Latched)

60 4008 ZP1WEN * ZeroPower RAM Enable 1 (Latched)

60 400A ZP2WDIS * ZeroPower RAM Disable 2 (Latched)

60 400C GSP Reset Low

60 400E MSP Reset Low

60 4010 LED 1 on

60 4012 LED 2 on

60 4014 LC1ON * Aux Control 1 High (Latched)

60 4016 LC2ON * Aux Control 2 High (Latched)

60 4018 ZP1WDIS * ZeroPower RAM Disable 1 (Latched)

60 401A ZP2WEN * ZeroPower RAM Enable 2 (Latched)

60 401C GSP Reset High

60 401E MSP Reset High

60 8000 {W} Clear Watch Dog (Address Strobe)

60 C000 {R} SW1

D15 Option Switch 7 ('0' = on)

D14 Option Switch 6 ('0' = on)

D13 Option Switch 5 ('0' = on)

D12 Option Switch 4 ('0' = on)

D11 Option Switch 3 ('0' = on)

D10 Option Switch 2 ('0' = on)

D9 Option Switch 1 ('0' = on)

D8 Option Switch 0 ('0' = on)

D7 Coin Switch 1 ('0' = on)

D6 Coin Switch 2 ('0' = on)

D5 Self-Test Switch ('0' = on)

D4 8 Bit ADC, End of Conversion = '1'

D3 12 Bit A/D, End of Conversion = '1'

D2 Vertical Sync from GSP

D1 Horizontal Sync from GSP

D0 Diagnostic Switch ('0' = on)

60 C000 {W} Clear Timer IRQ (Address Strobe)

/EXTBUS: Expansion Bus (2 MB)

80 0000 Driver ADSP

80 0000 - 80 7FFF {R/W} ADSP Program Memory 24K Bytes (32K space)
 Word or Longword access only
 PMD0 - PMD15 ==> 68010 D0 - D15 A1=1
 PMD16 - PMD23 ==> 68010 D0 - D7 A1=0

80 8000 - 80 BFFF {R/W} ADSP Data Memory 16K Bytes
 Word or Longword access only

81 0000 - 81 3FFF {R/W} Buffer Memory 16 K Bytes
 Word or Longword access only

81 8000 {W} Latches on Address Strobe (Data is ignored)

| | |
|---------|-----------------------|
| 81 8000 | LED 1 on |
| 81 8002 | LED 2 on |
| 81 8004 | unused |
| 81 8006 | Buffer Control Low |
| 81 8008 | unused |
| 81 800A | ADSP Bus Request Low |
| 81 800C | ADSP Halt Low |
| 81 800E | ADSP Reset Low |
| | |
| 81 8010 | LED 1 off |
| 81 8012 | LED 2 off |
| 81 8014 | unused |
| 81 8016 | Buffer Control High |
| 81 8018 | unused |
| 81 801A | ADSP Bus Request High |
| 81 801C | ADSP Halt High |
| 81 801E | ADSP Reset High |

81 8060 {W} Clear the Interrupt Generated by the ADSP.

83 8000 {R} Read Status D0 = /DIRQ, D1 = XFLAG

Note: The 68010 MUST set ADSP Bus Request Low before accessing ADSP Program Memory or ADSP Data Memory.

The ADSP internal address space is documented separately.

Main Board Memory Space for the Sound Board:

| | | |
|-----------|----------|---|
| 84 0000 W | MAINWR | Main writes to 'Main Latch', Sets 'Main Flag' |
| 84 C000 W | SRES | Main resets Sound Processor |
| | | |
| 84 0000 R | MAINRD | Main reads 'Sound Latch', resets 'Sound Flag' |
| 84 4000 R | MAINSTAT | Main reads Status: |
| | | D15 = 'Main Flag' |
| | | D14 = 'Sound Flag' |
| | | D13 = '0' |
| | | D12 = '1' |

 85 0000 Disk Interface

0000 - 8D FFFF ADSP II Graphics RAM (12)

8C 0000 - 8F FFFF ADSP Graphics RAM Bd

90 0000 - 9F FFFF RAM (1M)

/LSBUS LS Bus

A0 0000 {R}

A0 0000 {W} /WRO, Write to Shifter Interface and Coin Counters
 Latches on Address Strobe (Data is ignored)

A0 0000

A0 0002 SEL 1 Low

A0 0004 SEL 2 Low

A0 0006 SEL 3 Low

A0 0008 SEL 4 Low

A0 000A

A0 000C Coin Cointer 1 off

A0 000E Coin Counter 2 off

A0 0010

A0 0012 SEL 1 High

A0 0014 SEL 2 High

A0 0016 SEL 3 High

A0 0018 SEL 4 High

A0 001A

A0 001C Coin Counter 1 on

A0 001E Coin Cointer 2 on

A8 0000 {R} /SW2, Sixteen External Switch Inputs D0 - D14
 D15 = /SCBUSY
 D14 = /OPTO CENTER FLAG

A8 0000 {W} /WR1, Shifter Interface Latch, D8 - D15

B0 0000 {R} /RD2, Read 8 Bit A/D

B0 0000 {W} /WR2, Steering Wheel Latch, D8- D15

B8 0000 {R} /RD3, Read 12 Bit A/D

B8 0000 {W} /WR3, A/D Control

D8 - AD12BS 12 Bit A/D Byte Select

D7 - AD12CON 12 Bit A/D Write

D6 - AD12B 12 Bit A/D Address 1

D5 - AD12A 12 Bit A/D Address 0

D3 - ALE, SC 8 Bit A/D Write

D2 - ADDC 8 Bit A/D Address C

D1 - ADDB 8 Bit A/D Address B

D0 - ADDA 8 Bit A/D Address A

 /HSBUS: Hot Stuff Bus {R/W}

| | | |
|---------|-----|---------------------------|
| 0000 | GSP | Graphics System Processor |
| CO 0000 | GSP | HSTADRH |
| CO 0002 | GSP | HSTADRH |
| CO 0004 | GSP | HSTADRL |
| CO 0006 | GSP | HSTADRL |
| CO 0008 | GSP | HSTCTL |
| CO 000A | GSP | HSTCTL |
| CO 000C | GSP | HSTDATA |
| CO 000E | GSP | HSTDATA |

The Host Addresses are double mapped to permit Long Word Data Writes in Host auto-increment mode.

The GSP internal memory is documented separately.

| | | |
|---------|-----|------------------------|
| CO 4000 | MSP | Model System Processor |
| CO 4000 | MSP | HSTADRH |
| CO 4002 | MSP | HSTADRH |
| CO 4004 | MSP | HSTADRL |
| CO 4006 | MSP | HSTADRL |
| CO 4008 | MSP | HSTCTL |
| CO 400A | MSP | HSTCTL |
| CO 400C | MSP | HSTDATA |
| CO 400E | MSP | HSTDATA |

The Host Addresses are double mapped to permit Long Word Data Writes in Host auto-increment mode.

The MSP internal memory is documented separately.

=====
 /RAMEN: Ram and DUART {R/W}

| | |
|-------------------|--|
| FF 0000 | DUART |
| FF 4000 - FF 4FFE | ZRAM (4K Bytes, only 2K even bytes loaded) |
| FF 8000 - FF BFFF | RAM 0 (16K Bytes) |
| FF C000 - FF FFFF | RAM 1 (16K Bytes) |

The ZRAM Clock/Calender Locations are documented separately.

=====

Interrupts:

| Priority | Source | 68010 Interrupt Level |
|----------|--------------|-----------------------|
| 1 | DUART IRQ | 6 |
| 2 | Timer (4 ms) | 5 |
| 3 | LINK IRQ | 4 |
| 4 | GSP IRQ | 3 |
| 5 | ADSP IRQ | 2 |
| 6 | MSP IRQ | 1 |

Bus Errors: If DTACK is not generated as required, BERR will be asserted.

=====

Differences between MultiSync and Turbo

J. Margolin

12/12/88

e Turbo has 1 MB of VRAM and fills at a maximum rate of 48 MPixels/sec; the MultiSync has 512KB VRAM and fills at a maximum rate of 24 MPixels/sec.

In POLY Mode, each word writes only 8 pixels. They are:

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| D15 | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | P | | P | | P | | P | | P | | P | | P | | P |

The Scroll register scroll moves it a maximum of 8 pixels. Changing the HSync Register moves it either 4 or 8 pixels depending on the sync configuration.

In order to accomodate the SCOM IC, the SW1 Address has been moved to 60 C000. (see COMN.ASM)

SCOM is at 60 0000 (R/W).

/SCBUSY is at D15 on SW2 (A8 0000).

SCOM is reset by address SCRES (60 4000) as well as by System Reset.

MultiSync Display Modes

BCLK, VCLK, and SPEED are the jumper plugs by which the different sync modes are selected. The GSP Sync Registers must also be programmed appropriately.

| | | BCLK ---- | VCLK ---- | SPEED ---- | XOSC4 ----- |
|--|-----------|--------------|--------------|---------------|----------------|
| Medium Speed: | 512 x 384 | 16MZ | 4MHZ | none | not used |
| Standard Speed: | 320 x 240 | QB (6.6) | QB (6.6) | A,C | 40 MHz |
| | 640 x 240 | QB (13.3) | QB/2 (6.6) | B | " |
| | 512 x 240 | QB (10) | QB/2 (5) | A,B | " |
| Fast Standard (16.5 KHz Horiz., 53.6 Hz Vert.) | 512 x 288 | QB | QB/2 | B | 32 MHz |

The Multisync/Driver Sound Interface is a 16 bit parallel interface with all handshaking.

The 68010 on the Multisync Board writes to a 16 bit latch (MAINWR). This Write also sets a flag (MAINFLAG) that can be read by both the 68010 on the MultiSync board and by the 68000 on the Driver Sound Board.

When the 68000 on the Sound Board reads the latch (SOUNDRD), MAINFLAG is cleared. This is how the 68010 knows that the data has been read by the Sound Board.

When MAINFLAG is set by the MultiSync 68010 an interrupt is generated for the Sound 68000.

The Sound 68000 can also write to a latch (SOUNDWR) that sets a flag (SOUNDFLAG) that both processors can read.

When the MultiSync 68010 reads this latch (MAINRD), SOUNDFLAG is cleared. This is how the Sound 68000 knows that the data has been read by the MultiSync Board. SOUNDFLAG does not generate an interrupt for the MultiSync 68010.

MultiSync Addresses:

| | | | |
|----------|-----|----------|--|
| MAINWR | EQU | \$840000 | * Main Writes to Sound Board |
| MAINRD | EQU | \$840000 | * Main reads from Sound Board |
| MAINSTAT | EQU | \$844000 | * Main/Sound Status d15 = MAINFLAG d14 = SOUNDFLAG |
| RES | EQU | \$84C000 | * Reset Sound Board |

SRES is an address strobe (no data required) that resets the Sound Board. It triggers a one-shot that produces a reset pulse of several hundred microseconds.

As implemented, command codes \$55XX have been reserved for Self-Test functions. In particular, \$55A1 was assigned to the PLAY Sounds function.

The following code was used to implement this function. Note:

1. The subroutine to implement the interface protocol begins with a Reset and does extensive error checking and reporting. For example, the Sound Board echoes the data it receives. This was because it was part of Self-Test.
2. In the Game, the Sound Board was not reset for each command and there was little error checking. The MultiSync 68010 mostly just wrote to MAINWR.
3. The variable 'testtype' is used by Rick's program to call either the Play Sounds routines or the Shifter Test screen.
4. The command code \$55A1 is stripped by the Sound Board Operating System and is not passed to the Play Sounds Code on the Sound Board.
5. At the conclusion of Play Sounds, Rick's code executes an RTS. This causes the program to return to the code that called SB1.

```

XREF      testtype
* 55A1    'RETURN SOUND NUMBERS'
1:        MOVE.W  #$55A1,D0
          BSR      SNDSEND

          MOVE.W  #0,testtype          * Play Sounds
          JMP      ricksoundtest

*-----
XDEF      SNDSEND
SNDSEND   MOVE.W  #$2F00,SR          * Disable Interrupts
          CLR.W   SRES              * Sound Reset
          MOVE.W  D0,MAINWR
          MOVE.W  D0,TEMP1          * Save it
          MOVE.W  #$2400,SR        * Enable Interrupts

* Sound Reset Timeout is 500 MS = 500/16 = 31 VSYNC
          MOVE.W  #31,D7
SNDSD1    JSR      WAITSYNC
          BTST    #6,MAINSTAT      * Check for Sound Flag
          BNE     SNDSD3          * Got it
          SUB.W   #1,D7
          BNE     SNDSD1          * Try again

* Timeout Error                      Message 'Sound Board Timeout Error'
SNDSD2    MOVE.W  #SNDMSG+21,D0
          JSR      DOMSGW

          BSR      WAIT3SEC        * Wait 3 seconds

          CLR.W   D0              * Clear the Screen
          JSR      FILL
          ADD.L   #4,A7          * Return to Sound Menu (one JSR back)
          RTS

* Sound Board has read the data
SNDSD3    MOVE.W  MAINRD,D0
          CMP.W   TEMP1,D0        * Is it what we sent?
          BEQ     SNDSD4

* Data Error                      Message 'Interface Data Error'
          MOVE.W  #SNDMSG+22,D0
          JSR      DOMSGW

          BSR      WAIT3SEC        * Wait 3 seconds

          CLR.W   D0              * Clear the screen
          JSR      FILL
          ADD.L   #4,A7          * Return to Sound Menu (one JSR back)
SNDSD4    RTS

-----
XDEF      WAIT3SEC
WAIT3SEC  MOVE.W  #179,D0
          3LP    JSR      WAITSYNC      * Wait for Vertical Sync
          DBF     D0,WT3LP
          RTS

*=====

```

How to Implement it on the DS II

The DS II Board does not have a Parallel Interface with Handshaking.

Instead, the MultiSync 68010 asserts the 2101 Bus Request Line, which stalls the 2101 and tristates its external memory buses and allows the 68010 direct access to the 2101's external program and external data memory. (The 68010 cannot access the 2101's internal memory.)

Assign the following variables to the 68010's data memory:

| | | | |
|--------------|----------|---|--|
| MAINWR | \$808000 | * | 2101 Data Memory |
| MAINFLAG | \$808002 | * | 2101 Data Memory |
| MAINRD | \$808004 | * | 2101 Data Memory |
| SOUNDFLAG | \$808006 | * | 2101 Data Memory |
| DS2_BR_L | \$81400A | * | Latched address strobe |
| DS2_BR_H | \$81401A | * | Latched address strobe |
| DS2_RES_L | \$81400E | * | Latched address strobe |
| DS2_RES_H | \$81401E | * | Latched address strobe |
| DS2_IRQ2_L | \$814006 | * | Latched address strobe |
| DS2_IRQ2_H | \$814016 | * | Latched address strobe |
| DS2_LED_ON | \$814000 | * | Test LED On |
| DS2_LED_OFF | \$814000 | * | Test LED Off |
| DS2_2101_ACC | \$814004 | * | Latched Address strobe, normal mode |
| DS2_68K_ACC | \$814014 | * | Latched Address strobe, self-test only |
| DS2_RSTAT | \$810000 | * | Read IRQ Status: d0 = 0 is /ADSPIRQ |
| DS2_CGI | \$812000 | * | Clear ADSP Interrupt |

Assign the following variables to the 2101's data memory:

| 2101 address space | |
|--------------------|--------|
| SOUNDRD | H#0000 |
| MAINFLAG | H#0001 |
| SOUNDWR | H#0002 |
| SOUNDFLAG | H#0003 |

What the 68010 writes as MAINWR, the 2101 will read as SOUNDRD.
What the 2101 writes as SOUNDWR, the 68010 will read as MAINRD.

Both 68010 and 2101 will read and write MAINFLAG and SOUNDFLAG as required.

The 68010 will be able to generate an interrupt for the 2101.

```
CLR.W DS2_IRQ2_L
CLR.W DS2_IRQ2_H
```

The 2101 must configure IRQ2 as edge sensitive; otherwise it might get finished before the 680120 can pull it high again.

```

* 68010 writes to the interface from D0:
WR68K: CLR.W    DS2_BR_L          * Get the Bus

      MOVE.W    D0,MAINWR        * Write the data

      MOVE.W    #$0FFFF,MAINFLAG * Set MAINFLAG

      CLR.W     DS2_BR_H          * Release the Bus

      CLR.W     DS2_IRQ2_L        * Generate a 2101 Interrupt
      CLR.W     DS2_IRQ2_H

      RTS

```

* To check if the 2101 has taken the data:

* Returns with D0 = MAINFLAG

CHKMFLAG:

```

      CLR.W     DS2_BR_L          * Get the bus

      MOVE.W    MAINFLAG,D0      *

      CLR.W     DS2_BR_H          * Release the Bus

      RTS

```

The 68010 should not do this in a tight loop since it does stall the 2101.

Summary:

68010 writes:

```

The 68010 takes the 2101 bus;
Writes data to MAINWR;
Sets MAINFLAG to $0FFFF;
Releases the 2101 Bus;
Generates a 2101 interrupt.

```

68010 reads:

```

The 68010 takes the 2101 bus;
Reads SOUNDFLAG to see if there is data waiting;
If there is:
    Read MAINRD;
    Clear SOUNDFLAG.
Releases the 2101 Bus.

```

2101 Reads (after getting IRQ2):

```

Reads MAINFLAG to see if there is data waiting (H#FFFF);
If there is:
    Read SOUNDRD;
    Clear MAINFLAG.
(RTI).

```

2101 Writes:

```

Write data to SOUNDWR;
Set SOUNDFLAG to H#FFFF;

```

en SOUNDFLAG is H#0000 the 68010 has read the data.
(The 2101 should check SOUNDFLAG before writing new data.)

Timing for MultiSync II ROMs

M0 - ROM6 without /AS:

| | | | | |
|---------------|------------------|---------------|---------------|------------|
| Address Valid | GAL16V8-15 15 | ROM CE 200 | LS245 8-12 | Data Valid |
| | /ROM0 237 ns | | | |
| | <-----> | | | |

Clock Low to Address Valid = 62

Data Setup to Clock Low = 10

Data Required = $6 * 62.5 - 62 - 10 = 375 - 62 - 10 = 303$ ns

Addresses must go through LS244 Buffer 12-18, therefore will be slower than GAL16V8-15 by 3 ns.

ROM0 - ROM6 with /AS:

Clock High to /AS = 60

Data Setup to Clock Low = 10

$5 * 62.5 - 60 - 10 = 312.5 - 60 - 10 = 242.5$

ROM7 must not use /AS

| | | | | | | |
|---------------|------------------|-------------|------------------|---------------|---------------|------------|
| Address Valid | GAL16V8-15 15 | SLOOP 35 | GAL16V8-15 15 | ROM CE 200 | LS245 8-12 | Data Valid |
| | /ROM7 | | BS0 | 4.HM29 | | |
| | <-----> | | 277 ns | <-----> | | |

Address Valid to Data Required = 303 ns

MultiSync Turbo - Display Formats

The MultiSync Turbo supports the following Non-Interlaced formats:

| Speed ----- | Screen ----- | VRAM ----- | 2 Buffers ----- | Memory for Program and Data ----- |
|----------------|-----------------|---------------|--------------------|--------------------------------------|
| Medium | 512x384x8 | 512KB | 384KB | 128KB |
| Standard | 320x240x8 | 512KB | 150KB | 362KB |
| Standard | 512x240x8 | 512KB | 240KB | 272KB |
| Standard | 640x240x8 | 512KB | 300KB | 212KB |

Note that 512x240 does not have square pixels.

The system will support interlaced scanning assuming the monitors can interlace properly.

| Speed --- | Screen ----- | VRAM ----- | Buffers ----- | Memory for Program and Data ----- |
|--------------|-----------------|---------------|-------------------|--------------------------------------|
| standard | 512x480x8 | 512KB | 480KB (2 Buffers) | 32KB |
| | | | 240KB (1 Buffer) | 272KB |
| Standard | 640x480x8 | 512KB | 300KB (1 Buffer) | 212KB |

Note that 512x480 does not have square pixels.

MultiSync Turbo - Specifications

Main Board:

68010 at 8 MHz
1MB ROM (16 x 27512)
32KB RAM
4KB Zeropower RAM (Internal Battery; Timekeeper plus ZeroPower)
DUART with RS-232
8 Bit A/D
12 Bit A/D
16 Switch Inputs
Steering Wheel and Shifter Interfaces
Expansion Interface
SCUM IC

GSP Turbo: 34010
 512KB VRAM
 8 Bits/Pixel
 24M Pixels/sec Fill
 6 M Pixels/sec PixBlit

MSP: 34010 (Runs model math in C)
 128KB DRAM

ADSP Board:

ADSP-2100 DSP
8Kx16 Data RAM
8Kx24 Program RAM
256KB Graphics Data ROM
2x16KB Output RAM

Sound Board:

68000 at 8 MHz
64K/128K Bytes Program ROM (2 x 27256/27512)
16KB Program RAM
5220C Speech Synthesizer

32010 DSP
4KB RAM
768KB Sound Data ROM (12 x 27512)
12 Bit DAC Output
Filter
512 Byte Communications RAM

Microphone Input, Preamp, and Filter

* COMMON VARIABLES FOR GSPTST
 * Hardware Addresses, RAM variables, and constants
 * HARDWARE: MultiSync Main Rev 1, 2

~ MACROS (These are necessary in order to use Absolute Short addressing.)

DSB: MACRO * Assign Byte(s), using Equates.
 \1 EQU CURR
 CURR SET CURR+\2
 ENDM

DSW: MACRO * Assign Word(s), using Equates.
 \1 EQU CURR
 CURR SET CURR+\2*2
 ENDM

DSL: MACRO * Assign Long Word(s), using Equates.
 \1 EQU CURR
 CURR SET CURR+\2*4
 ENDM

ALIGN: MACRO * Align to an even byte address
 IFNE CURR/2*2-CURR
 CURR SET CURR+1
 ENDC
 ENDM

=====

Hardware Addresses:

| | | | |
|-------------------------|-----|----------|--|
| ROM | EQU | \$0 | * 1M Bytes in sixteen 27512s |
| *----- | | | |
| * OPT0 base is \$400000 | | | |
| OPTORD | EQU | \$400000 | |
| OPTORES | EQU | \$404000 | |
| CENRES | EQU | \$408000 | |
| *----- | | | |
| SCOM | EQU | \$600000 | * SCOM |
| SCRES | EQU | \$604000 | * Reset SCOM IC (Address Strobe) READ ONLY |
| *----- | | | |
| LED1OFF | EQU | \$604000 | * (W) LED 1 Off (Latched) |
| LED2OFF | EQU | \$604002 | * (W) LED 2 Off (Latched) |
| LC1OFF | EQU | \$604004 | * Aux Control 1 Low (Latched) |
| LC2OFF | EQU | \$604006 | * Aux Control 2 Low (Latched) |
| ZP1WEN | EQU | \$604008 | * ZeroPower RAM Enable 1 (Latched) |
| ZP2WDIS | EQU | \$60400A | * ZeroPower RAM Disable 1 (Latched) |
| GRESL | EQU | \$60400C | * (W) GSP Reset Low (Latched) |
| MRESL | EQU | \$60400E | * (W) MSP Reset Low (Latched) |
| | | | |
| LED1ON | EQU | \$604010 | * (W) LED 1 On (Latched) |
| LED2ON | EQU | \$604012 | * (W) LED 2 On (Latched) |
| LC1ON | EQU | \$604014 | * Aux Control 1 High (Latched) |
| ON | EQU | \$604016 | * Aux Control 2 High (Latched) |
| WDIS | EQU | \$604018 | * ZeroPower RAM Disable 1 (Latched) |
| ZP2WEN | EQU | \$60401A | * ZeroPower RAM Enable 1 (Latched) |
| GRESH | EQU | \$60401C | * (W) GSP Reset High (Latched) |
| MRESH | EQU | \$60401E | * (W) MSP Reset High (Latched) |

```

*-----
WDCLR    EQU    $608000    * (W) Clear Watch Dog

TROCLR   EQU    $60C000    * (W) Clear Timer IRQ
        EQU    $60C000    * (R) Switch Inputs
        EQU    $60C000    * (R) Option Switch = SW1.B
*-----

ADSP      EQU    $800000    * ADSP Board

* Program 80 0000    80 0000 - 80 3FFF is D0-D15, 80 4000 - 80 7FFF is D0-D7
* Data    80 8000
* STAT    81 0000
* CGINT    81 2000
* LATCHES 81 4000    Works on both Reads and Writes

ADSP_STAT EQU    $810000    * Read ADSP Status
ADSP_CLI  EQU    $812000    * Clear the ADSP Interrupt
*-----
* Latched Bits Work on both Reads and Writes, so let's be careful out there
ADSP_LED1_ON EQU    $814000    * ADSP LED 1 on
ADSP_2101_ACC EQU    $814004    * 2101 controls DS II Peripherals
ADSP_BUFF_L EQU    $814008    * ADSP Buffer Control Low
ADSP_BR_L EQU    $81400A    * ADSP Bus Request Low
ADSP_RES_L EQU    $81400E    * ADSP Reset Low

ADSP_LED1_OFF EQU    $814010    * LED 1 off
ADSP_68K_ACC EQU    $814014    * 68010 controls DS II Peripherals
ADSP_BUFF_H EQU    $814018    * ADSP Buffer Control High
ADSP_BR_H EQU    $81401A    * ADSP Bus Request High
P_RES_H EQU    $81401E    * ADSP Reset High
---
rites
ADSP_DACL EQU    $80C000    * DAC Left
ADSP_DACR EQU    $80C002    * DAC Right
ADSP_ROMADRL EQU    $80C004    * ROM Address Low (RA0 - RA15)
ADSP_ROMADRH EQU    $80C006    * ROM Address High (RA16-RA18)
ADSP_GINT EQU    $80C008    * Generate a 68010 Interrupt
*-----
* Read
ADSP_GROM EQU    $80C000    * Graphics ROM
*-----
* Not used by DS II
ADSP_LED2_ON EQU    $814000    * ADSP LED 2 on
ADSP_LED2_OFF EQU    $814012    * LED 2 off
ADSP_HALT_L EQU    $814002    * ADSP Halt Low
ADSP_HALT_H EQU    $814012    * ADSP Halt High
ADSP_BCON_L EQU    $814002    * ADSP Buffer Control Low
ADSP_BCON_H EQU    $814012    * Buffer Control High
*-----
MAINWR EQU    $840000    * Main Writes to Sound Board
MAINRD EQU    $840000    * Main reads from Sound Board
MAINSTAT EQU    $844000    * Main/Sound Status
SRES EQU    $84C000    * Reset Sound Board
*-----
DSKPEN EQU    $85C000
LATCH EQU    $85C800

XRAM32 EQU    $900000    * 64K 90 0000 - 90 FFFF 32K*8s
XRAM8 EQU    $904000    * 64K 90 4000 - 90 FFFF 8K*8s
XZRAM EQU    $910000    * 16K 91 0000 - 91 3FFF

```


| | | | | |
|----------|-----|-------------|--|-------------------|
| XROM0 | EQU | \$920000 | * 64K | 92 0000 - 92 FFFF |
| XROM1 | EQU | \$940000 | * 256K | 94 0000 - 97 FFFF |
| PLD65RD0 | EQU | \$914000 | * 16KB | 91 4000 - 91 7FFF |
| 5WR | EQU | \$914000 | * 16KB | 91 4000 - 91 7FFF |
| 5RD1 | EQU | \$918000 | * 16KB | 91 8000 - 91 BFFF |
| * XTRA1 | EQU | 930000 | 64KB | 93 0000 - 93 FFFF |
| *----- | | | | |
| SEL1L | EQU | \$0A00002 | * Shifter Control Select 1 Low | |
| SEL2L | EQU | \$0A00004 | * Shifter Control Select 2 Low | |
| SEL3L | EQU | \$0A00006 | * Shifter Control Select 3 Low | |
| SEL4L | EQU | \$0A00008 | * Shifter Control Select 4 Low | |
| CC1OFF | EQU | \$0A0000C | * Coin Counter 1 Off | |
| CC2OFF | EQU | \$0A0000E | * Coin Counter 2 Off | |
| SEL1H | EQU | \$0A00012 | * Shifter Control Select 1 High | |
| SEL2H | EQU | \$0A00014 | * Shifter Control Select 2 High | |
| SEL3H | EQU | \$0A00016 | * Shifter Control Select 3 High | |
| SEL4H | EQU | \$0A00018 | * Shifter Control Select 4 High | |
| CC1ON | EQU | \$0A0001C | * Coin Counter 1 On | |
| CC2ON | EQU | \$0A0001E | * Coin Counter 2 On | |
| *----- | | | | |
| SHLATCH | EQU | \$0A80000 | * W, Shifter Interface Latch, D8 - D15 | |
| SW2 | EQU | \$0A80000 | * R, Switch Inputs | |
| SWLATCH | EQU | \$0B00000 | * W, Steering Wheel Latch, D8 - D15 | |
| ADC8 | EQU | \$0B00000 | * R, 8 Bit A/D Output | |
| ADCON | EQU | \$0B80000 | * W, A/D Control | |
| 12 | EQU | \$0B80000 | * R, 12 Bit A/D Output | |
| *----- | | | | |
| GSPADRH | EQU | \$0C00000 | * TMS-34010 GSP Host Address High | |
| GSPADR | EQU | \$0C00002 | * TMS-34010 GSP Host Address (Long Word Address) | |
| GSPADRL | EQU | \$0C00004 | * TMS-34010 GSP Host Address Low | |
| GSPCTL | EQU | \$0C00008 | * TMS-34010 GSP Control | |
| GSPDATA | EQU | \$0C0000C | * TMS-34010 GSP Host Data | |
| MSPADRH | EQU | \$0C04000 | * TMS-34010 MSP Host Address High | |
| MSPADR | EQU | \$0C04002 | * TMS-34010 MSP Host Address (Long Word Address) | |
| MSPADRL | EQU | \$0C04004 | * TMS-34010 MSP Host Address Low | |
| MSPCTL | EQU | \$0C04008 | * TMS-34010 MSP Control | |
| MSPDATA | EQU | \$0C0400C | * TMS-34010 MSP Host Data | |
| *----- | | | | |
| DUART | EQU | \$0FFFF0000 | * Duart is high byte data only | |
| ZRAM | EQU | \$0FFFF4000 | * 2k x 8 Timekeeper, Even bytes only | |
| RAM | EQU | \$0FFFF8000 | * 32k Bytes in four 8k x 8 SRAMs | |
| *----- | | | | |
| USTACK | EQU | RAM+\$4000 | * User Stack | |
| *===== | | | | |
| DSK_PAR | EQU | DSKPEN+0 | | |
| DSK_PDR | EQU | DSKPEN+4 | | |
| DSK_EMR | EQU | DSKPEN+8 | | |
| ESR | EQU | DSKPEN+12 | | |
| PCR | EQU | DSKPEN+14 | | |
| PIR | EQU | DSKPEN+16 | | |
| DSK_PCRH | EQU | DSKPEN+20 | | |
| DSK_PARE | EQU | DSKPEN+22 | | |

```

DSK_PDR2      EQU      DSKPEN+24

DSK_RES_L     EQU      DSKLATCH+$00
DSK_ZNRES_L   EQU      DSKLATCH+$02
      ZWDIS1    EQU      DSKLATCH+$04
      ZWEN2     EQU      DSKLATCH+$06
DSK_320_RL    EQU      DSKLATCH+$08
DSK_LED_ON    EQU      DSKLATCH+$0E

DSK_RES_H     EQU      DSKLATCH+$10
DSK_ZNRES_H   EQU      DSKLATCH+$12
DSK_ZWEN1     EQU      DSKLATCH+$14
DSK_ZWDIS2    EQU      DSKLATCH+$16
DSK_320_RH    EQU      DSKLATCH+$18
DSK_LED_OFF   EQU      DSKLATCH+$1E
*=====
DS3_PMEMH     EQU      $800000      * Graphics Program Memory,
*                                D0 - D15 = GD8 - GD15
*                                $80 0000 - $80 3FFF

DS3_PMEML     EQU      $804000      * Graphics Program Memory,
*                                D0 - D7 = GD0 - GD7
*                                $80 4000 - $80 7FFF

DS3_DMEM      EQU      $808000      * Graphics Data Memory
*                                $80 8000 - $80 BFFF

S68WR         EQU      $822000      * Sound Port Write Data
S68RD0        EQU      $822000      * Sound Port Read Data
      {D1       EQU      $822800      * Sound Port Read Status
      :         EQU      $823000      * Clear Sound Interrupt (/LIRQ)

DS3LATCH      EQU      $823800      * Latched Addresses
SND_RES_L     EQU      $823800      * Sound Processor
X_RES_L       EQU      $823802      * X Processor
GR_BR_L       EQU      $823804      * Graphics Processor Bus Request
GR_RES_L      EQU      $823806      * Graphics Processor Reset
GR_ACC_OFF    EQU      $823808      * Graphics 68010 Access disabled
DS3LED_ON     EQU      $82380E      * DS III LED on

SND_RES_H     EQU      $823810      * Sound Processor
X_RES_H       EQU      $823812      * X Processor
GR_BR_H       EQU      $823814      * Graphics Processor Bus Request
GR_RES_H      EQU      $823816      * Graphics Processor
GR_ACC_ON     EQU      $823818      * Graphics 68010 Access enabled
DS3LED_OFF    EQU      $82381E      * DS III LED off

G68WR         EQU      $820000      * Graphics Port Write Data
G68RD0        EQU      $820000      * Graphics Port Read Data
G68RD1        EQU      $820800      * Graphics Port Read Status
GCGI          EQU      $821000      * Clear Graphics Interrupt (/ADSPIRQ)
*=====
* RAM variables will be addressed in Absolute Short mode. (ZRAM is out of range)
*
* In order for the assembler to recognize Absolute Short Negative, the address
  must be sign extended to 32 bits. Example: FFFFC000 instead of 00FFC000
  {      SET      RAM      * RAM Hardware Address

* Put variables here with DSB, DSW, and DSL macros

```

| | | |
|-----|---------|-----------------|
| DSB | DYR,1 | * Clock Display |
| DSB | DMON,1 | |
| DSB | DDATE,1 | |
| DSB | DDAY,1 | |
| DSB | DHOUR,1 | |
| DSB | DMIN,1 | |
| DSB | DSEC,1 | |

| | |
|-----|-----------|
| DSB | AD8VAL,8 |
| DSB | COUNTER,1 |

ALIGN

| | |
|-----|-----------|
| DSW | AD12VAL,4 |
| DSW | F_RED,1 |
| DSW | F_GREEN,1 |
| DSW | F_BLUE,1 |

*=====

| | | |
|-----|----------------|---|
| DSW | MENUSEL,1 | * Main Menu Select |
| DSW | SFMENUSEL,1 | * Special Functions Menu Select |
| DSW | MTPSEL,1 | * Menu Select for Monitor Test Patterns |
| DSW | CMENSEL,1 | |
| DSW | SUB1MENU_SEL,1 | * Sub 1 Menu Select |
| DSW | SUB2MENU_SEL,1 | * Sub 2 Menu Select |
| DSW | MENU_BASE,1 | |
| DSW | MENU_LAST,1 | |
| DSW | MENU_INDEX,1 | |

| | |
|-----|--------|
| DSW | SW_0,8 |
| DSW | SW_1,8 |
| DSW | SW_2,8 |
| DSW | SW_3,8 |
| DSW | LTSW,8 |
| DSW | RTSW,8 |

| | |
|-----|---------|
| DSW | TEMP1,1 |
| DSW | TEMP2,1 |
| DSW | TEMP3,1 |
| DSW | TEMP4,1 |

| | | |
|-----|----------|-------------------------|
| DSW | STROM,24 | * Self-Test ROM Results |
| DSW | STRAM,8 | * Self-Test RAM Results |

| | |
|-----|----------|
| DSL | LOOP,1 |
| DSL | TBLADR,1 |

| | |
|-----|------------|
| DSW | VALUE,1 |
| DSW | ERRCOUNT,1 |

| | |
|-----|-----------|
| DSW | TBLEND,1 |
| DSW | MSPFLAG,1 |

| | |
|-----|-----------|
| DSL | BERRLOG,1 |
|-----|-----------|

| | | |
|-----|------------|-----------------------------------|
| DSW | LINE_HI,1 | * used for measuring line voltage |
| DSW | LINE_LO,1 | * |
| DSW | LINE_AVG,1 | * Line Average (DC) Level |
| DSW | LINE_RMS,1 | * RMS Line Voltage |
| DSL | LINE_MS,1 | * Line Mean Squared Level |

| | | |
|-----|---------------|-----------------------------------|
| DSW | STW_TIME,1 | * Steering Wheel Time |
| DSW | STW_AMPL,1 | * Steering Wheel Amplitude |
| DSW | STW_FORCE,1 | * Steering Wheel Force |
| DSW | FBFLAG,1 | * Feedback (routine) Flag |
| DSW | OPTO_FLAG,1 | |
| DSW | BCDVAR,1 | |
| DSW | BCDVAR2,1 | |
| DSW | SIGN,1 | |
| DSW | STBL,1 | * Sine Table address |
| DSW | COUNTDIR,1 | |
| | | |
| DSW | STWMIN,1 | * Steering Wheel Minimum |
| DSW | STWMAX,1 | * Steering Wheel Maximum |
| DSW | STWCEN,1 | * Steering Wheel Center |
| DSW | STWPOS,1 | * Desired Steering Wheel Position |
| DSW | STWCYC1,1 | * Cycles MSD |
| DSW | STWCYC2,1 | * Cycles |
| DSW | STWCYC3,1 | * Cycles LSD |
| | | |
| DSW | LFSREG,1 | * Linear Feedback Shift Register |
| | | |
| DSL | ADRPTR,1 | |
| DSW | RCOUNTER,1 | |
| DSW | YADR,1 | |
| DSW | SCRVAL,1 | |
| DSW | SCRSGN,1 | |
| | | |
| DSW | POS_LIMIT,1 | |
| DSW | NEG_LIMIT,1 | |
| | | |
| DSW | SOUNDREV,1 | |
| | | |
| DSW | OPTO_PSN,1 | |
| DSW | OPTO_PSN2,1 | |
| DSW | OPTO_LAST,1 | |
| DSW | OPTOCEN,1 | |
| DSW | OPCENCNT,1 | |
| | | |
| DSW | DCOUNT,1 | |
| | | |
| DSW | BCONMSG,1 | |
| DSL | ASFB_MENSEL,1 | |
| DSL | BCON_A,1 | |
| DSL | BCON_B,1 | |
| DSW | SOMDATA,1 | |

| | | | |
|----------------------------------|--|----------------|---------|
| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-01 | Rev / F |
| GAMES ENGINEERING | | PROJECT: | |

Page 1 of 4



| | |
|-----------------|--------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: AJ | A046901-01 |
| Design Eng: JM | Comp. Eng: |
| Proj. Eng: RM | Mfg. Eng: DW |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|---------------------|----------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | ECN 13481 | | | | | | |
| C | ECN 13482 | | | | | | |
| D | ECN 13517 | | | | | | |
| E | ECN 13817 | | | | | | |
| F | ECN 14093 <i>SW</i> | 11-27-90 | JM | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|-------------------------------|--|
| 1 | 044999-01 | 1 | P.C. Board | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | 122015-102 | 24 | CAP, .001μF, 50V, 10% | C44-63, C228, C359, C360, C378 |
| 6 | | | | |
| 7 | 122002-103 | 1 | CAP, .01μF, 50V, CER | C2 |
| 8 | 122002-104 | 258 | CAP, .1μF, 50V, CER | C3-14, C16, C19-21, C24-43, C65-78, C80-82, C85-87, C94-106, C114-117, C123, C124, C129-137, C140, C141, C143, C144, C146-189, C193-202, C204-227, C230-238, C243-249, C251-259, C264-273, C275-293, C298, C299, C306-309, C315-320, C330-333, C341, 342, C349-352, C354, C355, C358, C364, C365, C367, C369-377, C379 |
| 9 | 122015-224 | 1 | CAP, .22μF, 50V, CER | C142 |
| 10 | 122016-102 | 5 | CAP, 1000PF, 100V, CER | C138, C139, C361-363 |
| 11 | 122016-101 | 4 | CAP, 100PF, 100V, CER | C83, C84, C335, C336, |
| 12 | 124000-107 | 1 | CAP, 100μF, 35V, ELEC | C1 |
| 13 | 122016-100 | 5 | CAP, 10PF, 100V, CER | C79, C323-326 |
| 14 | 127001-106 | 1 | CAP, 10μF, 20V, TANT | C368 |
| 15 | 124000-106 | 5 | CAP, 10μF, 35V, ELEC | C125-128, C145 |
| 16 | | | | |
| 17 | 123004-477 | 1 | CAP, 470μF, 16V, ELEC, RADIAL | C366 |
| 18 | 122016-470 | 3 | CAP, 47PF, 100V, CER | C229, C250, C274 |
| 19 | | | | |
| 20 | | | | |
| 21 | | | | |

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| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-01 | REV / F |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: | Page 2 of 4 |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|---|---|
| 22 | | | | |
| 23 | 179118-011 | 9 | CONN, 11 CKT, HDR, .100 CTR | J2-6,J8-10,J13 |
| 24 | 179069-012 | 1 | CONN, 12 CKT, HDR, .250 CTR | J1 |
| 25 | 179261-016 | 1 | CONN, 16 CKT, HDR, .1 X .1 DUAL | J15 |
| 26 | 179261-026 | 1 | CONN, 26 CKT, HDR, .1 X .1 DUAL | J14 |
| 27 | 179177-006 | 2 | CONN, 6 CKT, HDR, .100 CTR | SPEED,VCLK. |
| 28 | 179177-004 | 1 | CONN, 4 CKT, HDR, .100 CTR | BCLK. |
| 29 | 179069-009 | 1 | CONN, 9 CKT, HDR, .250 CTR | J12 |
| 30 | 179021-060 | 1 | CONN, HDR,60 CKT, .1 CTR | J7 |
| 31 | | | | |
| 32 | | | | |
| 33 | 131048-002 | 6 | DIODE, 1N4002 | CR5,CR7,CR8,CR13,CR18, CR23 |
| 34 | | | | |
| 35 | | | | |
| 36 | 131009-213 | 1 | DIODE, 1N4740A, 10V, ZENER, 5% | CR21 |
| 37 | | | | |
| 38 | 131027-002 | 9 | DIODE, MV5053, LIGHT EMIT | CR1,CR2,CR6,CR9-12, CR14,CR22 |
| 39 | | | | |
| 40 | | | | |
| 41 | | | | |
| 42 | 137199-002 | 6 | IC, 2149, 45NSEC | 30S,30U,30W,40S,40U, 40W |
| 43 | | | | |
| 44 | 137553-002 | 16 | IC, VRAM, 64KX4, 150NSEC | 60P,60S,60U,60W,70P, 70S,70U,70W,85P,85S, 85U,85W,95P,95S,95U, 95W |
| | COMMENT | | 137553-001, IC, 64KX4 VRAM 120NSEC, AND 137553-003, IC, 64KX4, VRAM,100NSEC, AS SUBSTITUTE FOR ITEM 44 | |
| 45 | | | | |
| 46 | 137580-001 | 1 | IC, 4066B | 205B |
| 47 | 137546-003 | 4 | IC, 4464, 64K X 4, DRAM | 5K,15K,25K,35K |
| 48 | 137052-001 | 1 | IC, 7406 | 110C |
| 49 | 137460-001 | 1 | IC, 74ALS08 | 90M |
| 50 | 137517-001 | 5 | IC, 74ALS138 | 80M,110K,160K,180C, 200M |
| 51 | 137467-001 | 1 | IC, 74ALS139 | 180E |
| 52 | 137470-001 | 3 | IC, 74ALS161 | 100M,160E,170K |
| 53 | 137440-001 | 2 | IC, 74ALS245 | 15M,35M |
| 54 | 137464-001 | 2 | IC, 74ALS32 | 160H,200L |
| 55 | 137548-001 | 5 | IC, 74ALS574 | 20P,50S,50U,50W,120M |
| 56 | 137156-001 | 1 | IC, 74ALS74 | 140M |
| 57 | 137480-001 | 2 | IC, 74AS00 | 135U,190E |
| 58 | 137484-001 | 2 | IC, 74AS08 | 70Y,140U |
| 59 | 137522-001 | 1 | IC, 74AS138 | 60Y |
| 60 | 137487-001 | 2 | IC, 74AS32 | 135K,160U |
| 61 | 137547-001 | 8 | IC, 74AS573 | 25M,50Y,120P,120W, 120Y,135P,135W,150U |

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| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-01 | REV / F |
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| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|------------------------|---|
| 62 | 137437-001 | 2 | IC, 74F04 | 150W,160M |
| 63 | 137583-001 | 1 | IC, 74F11 | 140K |
| 64 | 137343-001 | 1 | IC, 74F161 | 150Y |
| 65 | 137502-001 | 2 | IC, 74F244 | 5M,120U |
| 66 | 137436-001 | 3 | IC, 74F74 | 120H,135C,135H |
| 67 | 137605-001 | 1 | IC, 74HC14 | 195W |
| 68 | | | | |
| 69 | 137268-001 | 2 | IC, 74LS123 | 40H,50H |
| 70 | 137177-001 | 1 | IC, 74LS138 | 195R |
| 71 | 137056-001 | 2 | IC, 74LS14 | 75H,185W |
| 72 | 137417-001 | 1 | IC, 74LS148 | 170H |
| 73 | 137128-001 | 2 | IC, 74LS193 | 185T,195T |
| 74 | 137060-001 | 1 | IC, 74LS20 | 150K |
| 75 | 137038-001 | 12 | IC, 74LS244 | 60B,140C,140P, 150E,160C,170E,200H, 200J,210H,210J,210K, 210N |
| 76 | 137134-001 | 13 | IC, 74LS245 | 30P,30Y,40Y,150C,170C, 190N,200F,200N, 200P,210F,210L,210M, 210P |
| 77 | 137137-001 | 3 | IC, 74LS259 | 65C,75C,135Y |
| 78 | 137144-001 | 5 | IC, 74LS374 | 30B,85C,95C,185R,185U |
| 79 | 137146-001 | 3 | IC, 74LS393 | 120K,140H,190C |
| 80 | 137023-001 | 4 | IC, 74LS74 | 135M,150H,160W,175U |
| 81 | 137597-001 | 1 | IC, 7812 | Q4 |
| 82 | 137581-001 | 1 | IC, 7905 | Q3 |
| 83 | | | | |
| 84 | 137403-001 | 1 | IC, MC1488 | 210A |
| 85 | 137263-001 | 1 | IC, MC1489AL | 210B |
| 86 | 137513-001 | 3 | IC, 74AS823 | 20S,20U,20W |
| 87 | 137243-001 | 1 | IC, ADC0809 | 45B |
| 88 | 137535-006 | 4 | IC, RAM, 8KX8, 150NSEC | 200C,200D,210C,210D |
| 89 | 137614-001 | 1 | IC, AD711KN | 15B |
| 90 | | | | |
| 91 | 144008-002 | 2 | OSC, 32MHZ | XOSC1,XOSC4 |
| 92 | | | | |
| 93 | | | | |
| 94 | | | | |
| 95 | 110005-001 | 1 | RES, 0, 5%, 1/4W | R155 |
| 96 | 110000-100 | 2 | RES, 10, 5%, 1/4W | R172,R173 |
| 97 | 110000-101 | 39 | RES, 100, 5%, 1/4W | R1-26,R55,R98-101, R109-111,R113-115, R177,R178 |
| 98 | 110000-104 | 2 | RES, 100K, 5%, 1/4W | R147,R148 |
| 99 | 110000-103 | 21 | RES, 10K, 5%, 1/4W | R74,R75,R84-88, R145,R146,R149,R150, R160,R161,R168-171, R182-184,R190 |
| 100 | 110000-151 | 2 | RES, 150, 5%, 1/4W | R162,R163 |
| 101 | 110000-102 | 38 | RES, 1K, 5%, 1/4W | R29-45,R57-60,R68, R80,R81,R125-131,R134, |

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| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-01 | REV / F |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: | Page 4 of 4 |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|-----------------------------------|--|
| 102 | 110000-225 | 1 | RES, 2.2M, 5%, 1/4W | R185,R188,R191,R193, R194,R197 |
| 103 | 110000-221 | 10 | RES, 220, 5%, 1/4W | R189 ? R62,R63,R70-73,R76, R124,R151,R152 |
| 104 | 110000-274 | 1 | RES, 270K, 5%, 1/4W | R192 |
| 105 | | | | |
| 106 | 110000-330 | 22 | RES, 33, 5%, 1/4W | R89-96,R102-107, R116-123 |
| 107 | 110001-331 | 1 | RES, 330, 5%, 1/2W | R187 |
| 108 | 110000-472 | 10 | RES, 4.7K, 5%, 1/4W | R49-54,R61,R77,R78, R132 |
| 109 | 118010-472 | 1 | RES, 4.7KX9, 5%, 1/8W, SIP(10PIN) | RN6 |
| 110 | | | | |
| 111 | 110000-471 | 5 | RES, 470, 5%, 1/4W | R46-48,R82,R83 |
| 112 | 118010-471 | 2 | RES, 470X9, 5%, 1/8W, SIP(10PIN) | RN1,RN2 |
| 113 | 110000-473 | 1 | RES, 47K, 5%, 1/4W | R79 |
| 114 | | | | |
| 115 | | | | |
| 116 | 110000-820 | 1 | RES, 82, 5%, 1/4W | R186 |
| 117 | | | | |
| 118 | 118015-001 | 3 | RES, R2R LADDER | RN3-5 |
| 119 | | | | |
| 120 | 179259-016 | 1 | SOCKET, 16 PIN, .300" | 195U |
| 121 | 179259-020 | 1 | SOCKET, 20 PIN, .300" | 200K |
| 122 | 179257-024 | 2 | SOCKET, 24 PIN, .600" | 200E,210E |
| 123 | 179257-028 | 16 | SOCKET, 28 PIN, .600" | 200R,200S,200T,200U 200V,200W,200X,200Y, 210R,210S,210T,210U, 210V,210W,210X,210Y |
| 124 | 179257-040 | 1 | SOCKET, 40 PIN, .600" | 200A |
| 125 | 179256-064 | 1 | SOCKET, 64 PIN, .900" | 190K |
| 126 | 179237-068 | 3 | SOCKET, 68 PIN | 55L-MSP,120S-PSP, 150S-GSP |
| 127 | | | | |
| 128 | 160031-008 | 1 | SWITCH, 8 POS DIP | SW1 |
| 129 | | | | |
| 130 | 179051-001 | 23 | TEST POINT | TP3,+5V1,+5V2,-5V1, BLU.,GND1-9,GRN.,RED., +12V1,+15V1,-22V1, CSYNC.,DIAGN.,RESET., WD-DIS |
| 131 | | | | |
| 132 | 133041-001 | 6 | TRANS, 2N3904 | Q5,Q7,Q9,Q11-13 |
| 133 | 133040-001 | 3 | TRANS, 2N3906 | Q6,Q8,Q10 |
| 134 | 133042-001 | 2 | TRANS, 2N6044 | Q1,Q2 |
| 135 | 178217-001 | 1 | INSULATOR, CRYSTAL, | (XTAL1) |
| 136 | 144000-011 | 1 | XTAL, 3.6864, STANDUP | XTAL1 |
| 137 | 144008-003 | 1 | XTAL, 48 MHZ, OSCILLATOR MODULE | XOSC2 |
| 138 | 144008-005 | 1 | XTAL, 50 MHZ, OSCILLATOR MODULE | XOSC3 |

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| GAMES ENGINEERING | | PROJECT: HARD DRIVIN | |
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|-----------------|------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: AJ | A046901-04,05,06 |
| Design Eng: | Comp. Eng: |
| Proj. Eng: JM | Mfg. Eng: DW |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|-----------------------|----------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | REVISED PER ECN 13956 | | | | | | |
| C | REVISED PER ECN 14092 | 11-27-88 | | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|-------------------------------|---|
| 1 | 044999-01 | 1 | P.C. Board | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | 122015-102 | 24 | CAP, .001μF, 50V, 10% | C44-63,C228,C359,C360,C378 |
| 6 | | | | |
| 7 | 122002-103 | 1 | CAP, .01μF, 50V, CER | C2 |
| 8 | 122002-104 | 258 | CAP, .1μF, 50V, CER | C3-14,C16,C19-21,C24-43,C65-78,C80-82,C85-87,C94-106,C114-117,C123,C124,C129-137,C140,C141,C143,C144,C146-189,C193-202,C204-227,C230-238,C243-249,C251-259,C264-273,C275-293,C298,C299,C306-309,C315-320,C330-333,C341,342,C349-352,C354,C355,C358,C364,C365,C367,C369-377,C379 |
| 9 | 122015-224 | 1 | CAP, .22μF, 50V, CER | C142 |
| 10 | 122016-102 | 5 | CAP, 1000PF, 100V, CER | C138,C139,C361-363 |
| 11 | 122016-101 | 4 | CAP, 100PF, 100V, CER | C83,C84,C335,C336, |
| 12 | 124000-107 | 1 | CAP, 100μF, 35V, ELEC | C1 |
| 13 | 122016-100 | 5 | CAP, 10PF, 100V, CER | C79,C323-326 |
| 14 | 127001-106 | 1 | CAP, 10μF, 20V, TANT | C368 |
| 15 | 124000-106 | 5 | CAP, 10μF, 35V, ELEC | C125-128,C145 |
| 16 | | | | |
| 17 | 123004-477 | 1 | CAP, 470μF, 16V, ELEC, RADIAL | C366 |
| 18 | 122016-470 | 3 | CAP, 47PF, 100V, CER | C229,C250,C274 |
| 19 | | | | |
| 20 | | | | |
| 21 | | | | |

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| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-02 | REV / C |
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| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|--|---|
| 22 | | | | |
| 23 | 179118-011 | 9 | CONN, 11 CKT, HDR, .100 CTR | J2-6,J8-10,J13 |
| 24 | 179069-012 | 1 | CONN, 12 CKT, HDR. .250 CTR | J1 |
| 25 | 179261-016 | 1 | CONN, 16 CKT, HDR, .1 X .1 DUAL | J15 |
| 26 | 179261-026 | 1 | CONN, 26 CKT, HDR, .1 X .1 DUAL | J14 |
| 27 | 179177-006 | 2 | CONN, 6 CKT, HDR, .100 CTR | SPEED,VCLK. |
| 28 | 179177-004 | 1 | CONN, 4 CKT, HDR, .100 CTR | BCLK. |
| 29 | 179069-009 | 1 | CONN, 9 CKT, HDR, .250 CTR | J12 |
| 30 | 179021-060 | 1 | CONN, HDR,60 CKT, .1 CTR | J7 |
| 31 | | | | |
| 32 | | | | |
| 33 | 131048-002 | 6 | DIODE, 1N4002 | CR5,CR7,CR8,CR13,CR18, CR23 |
| 34 | | | | |
| 35 | | | | |
| 36 | 131009-213 | 1 | DIODE, 1N4740A, 10V, ZENER, 5% | CR21 |
| 37 | | | | |
| 38 | 131027-002 | 9 | DIODE, MV5053, LIGHT EMIT | CR1,CR2,CR6,CR9-12, CR14,CR22 |
| 39 | | | | |
| 40 | | | | |
| 41 | | | | |
| 42 | 137199-002 | 6 | IC, 2149, 45NSEC | 30S,30U,30W,40S,40U, 40W |
| 43 | | | | |
| 44 | 137553-002 | 16 | IC, VRAM, 64KX4, 150NSEC | 60P,60S,60U,60W,70P, 70S,70U,70W,85P,85S, 85U,85W,95P,95S,95U, 95W |
| | COMMENT | | 137553-001, IC, 64KX4 VRAM 120NSEC,AND 137553-003, IC, 64KX4, VRAM, 100NSEC, AS SUBSTITUE FOR ITEM 44 | |
| 45 | | | | |
| 46 | 137580-001 | 1 | IC, 4066B | 205B |
| 47 | | | | |
| 48 | 137052-001 | 1 | IC, 7406 | 110C |
| 49 | 137460-001 | 1 | IC, 74ALS08 | 90M |
| 50 | 137517-001 | 5 | IC, 74ALS138 | 80M,110K,160K,180C, 200M |
| 51 | 137467-001 | 1 | IC, 74ALS139 | 180E |
| 52 | 137470-001 | 3 | IC, 74ALS161 | 100M,160E,170K |
| 53 | | | | |
| 54 | 137464-001 | 2 | IC, 74ALS32 | 160H,200L |
| 55 | 137548-001 | 5 | IC, 74ALS574 | 20P,50S,50U,50W,120M |
| 56 | 137156-001 | 1 | IC, 74ALS74 | 140M |
| 57 | 137480-001 | 2 | IC, 74AS00 | 135U,190E |
| 58 | 137484-001 | 2 | IC, 74AS08 | 70Y,140U |
| 59 | 137522-001 | 1 | IC, 74AS138 | 60Y |
| 60 | 137487-001 | 2 | IC, 74AS32 | 135K,160U |
| 61 | 137547-001 | 7 | IC, 74AS573 | 50Y,120P,120W,120Y, 135P,135W,150U |

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| Title / ASSY, SUB, MULTISYNC PCB | | P/L A044998-02 | REV / C |
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| PARTS LIST SPECIFICATION | | | Page 3 of 4 |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|------------|-----|------------------------|---|
| 62 | 137437-001 | 2 | IC, 74F04 | 150W,160M |
| 63 | 137583-001 | 1 | IC, 74F11 | 140K |
| 64 | 137343-001 | 1 | IC, 74F161 | 150Y |
| 65 | 137502-001 | 1 | IC, 74F244 | 120U |
| 66 | 137436-001 | 3 | IC, 74F74 | 120H,135C,135H |
| 67 | 137605-001 | 1 | IC, 74HC14 | 195W |
| 68 | | | | |
| 69 | 137268-001 | 2 | IC, 74LS123 | 40H,50H |
| 70 | 137177-001 | 1 | IC, 74LS138 | 195R |
| 71 | 137056-001 | 2 | IC, 74LS14 | 75H,185W |
| 72 | 137417-001 | 1 | IC, 74LS148 | 170H |
| 73 | 137128-001 | 2 | IC, 74LS193 | 185T,195T |
| 74 | 137060-001 | 1 | IC, 74LS20 | 150K |
| 75 | 137038-001 | 12 | IC, 74LS244 | 60B,140C,140P, 150E,160C,170E,200H, 200J,210H,210J,210K, 210N |
| 76 | 137134-001 | 13 | IC, 74LS245 | 30P,30Y,40Y,150C,170C, 190N,200F,200N, 200P,210F,210L,210M, 210P |
| 77 | 137137-001 | 3 | IC, 74LS259 | 65C,75C,135Y |
| 78 | 137144-001 | 5 | IC, 74LS374 | 30B,85C,95C,185R,185U |
| 79 | 137146-001 | 3 | IC, 74LS393 | 120K,140H,190C |
| 80 | 137023-001 | 4 | IC, 74LS74 | 135M,150H,160W,175U |
| 81 | 137597-001 | 1 | IC, 7812 | Q4 |
| 82 | 137581-001 | 1 | IC, 7905 | Q3 |
| 83 | | | | |
| 84 | 137403-001 | 1 | IC, MC1488 | 210A |
| 85 | 137263-001 | 1 | IC, MC1489AL | 210B |
| 86 | 137513-003 | 3 | IC, 74BCT29823 | 20S,20U,20W |
| 87 | 137243-001 | 1 | IC, ADC0809 | 45B |
| 88 | 137535-004 | 4 | IC, RAM, 8KX8, 100NSEC | 200C,200D,210C,210D |
| 89 | 137614-001 | 1 | IC, AD711KN | 15B |
| 90 | | | | |
| 91 | 144008-002 | 2 | OSC, 32MHZ | XOSC1,XOSC4 |
| 92 | | | | |
| 93 | | | | |
| 94 | | | | |
| 95 | 110005-001 | 1 | RES, 0, 5%, 1/4W | R155 |
| 96 | 110000-100 | 2 | RES, 10, 5%, 1/4W | R172,R173 |
| 97 | 110000-101 | 39 | RES, 100, 5%, 1/4W | R1-26,R55,R98-101, R109-111,R113-115, R177,R178 |
| 98 | 110000-104 | 2 | RES, 100K, 5%, 1/4W | R147,R148 |
| 99 | 110000-103 | 21 | RES, 10K, 5%, 1/4W | R74,R75,R84-88, R145,R146,R149,R150, R160,R161,R168-171, R182-184,R190 |
| 100 | 110000-151 | 2 | RES, 150, 5%, 1/4W | R162,R163 |
| 101 | 110000-102 | 38 | RES, 1K, 5%, 1/4W | R29-45,R57-60,R68, R80,R81,R125-131,R134, |

| Title / ASSY, SUB, MULTISYNC PCB | | | P/L A044998-02 | REV / C |
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| GAMES ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: HARD DRIVIN | | Page 4 of 4 |
| ITEM | PART NO | QTY | Description | Ref. Designators |
| 102 | 110000-225 | 1 | RES, 2.2M, 5%, 1/4W | R185,R188,R191,R193, R194,R197 |
| 103 | 110000-221 | 10 | RES, 220, 5%, 1/4W | R189 R62,R63,R70-73,R76, R124,R151,R152 |
| 104 | 110000-274 | 1 | RES, 270K, 5%, 1/4W | R192 |
| 105 | | | | |
| 106 | 110000-330 | 22 | RES, 33, 5%, 1/4W | R89-96,R102-107, R116-123 |
| 107 | 110001-331 | 1 | RES, 330, 5%, 1/2W | R187 |
| 108 | 110000-472 | 10 | RES, 4.7K, 5%, 1/4W | R49-54,R61,R77,R78, R132 |
| 109 | 118010-472 | 1 | RES, 4.7KX9, 5%, 1/8W, SIP(10PIN) | RN6 |
| 110 | | | | |
| 111 | 110000-471 | 5 | RES, 470, 5%, 1/4W | R46-48,R82,R83 |
| 112 | 118010-471 | 2 | RES, 470X9, 5%, 1/8W, SIP(10PIN) | RN1,RN2 |
| 113 | 110000-473 | 1 | RES, 47K, 5%, 1/4W | R79 |
| 114 | | | | |
| 115 | | | | |
| 116 | 110000-820 | 1 | RES, 82, 5%, 1/4W | R186 |
| 117 | | | | |
| 118 | 118015-001 | 3 | RES, R2R LADDER | RN3-5 |
| 119 | 179259-018 | 4 | SOCKET, 18 PIN, .300 | 5K,15K,25K,35K |
| 120 | 179259-016 | 1 | SOCKET, 16 PIN, .300" | 195U |
| 121 | 179259-020 | 5 | SOCKET, 20 PIN, .300" | 5M,15M,25M,35M,200K |
| 122 | 179257-024 | 2 | SOCKET, 24 PIN, .600" | 200E,210E |
| 123 | 179257-028 | 16 | SOCKET, 28 PIN, .600" | 200R,200S,200T,200U 200V,200W,200X,200Y, 210R,210S,210T,210U, 210V,210W,210X,210Y 200A |
| 124 | 179257-040 | 1 | SOCKET, 40 PIN, .600" | 190K |
| 125 | 179256-064 | 1 | SOCKET, 64 PIN, .900" | 55L-MSP,120S-PSP, 150S-GSP |
| 126 | 179237-068 | 3 | SOCKET, 68 PIN | |
| 127 | | | | |
| 128 | 160031-008 | 1 | SWITCH, 8 POS DIP | SW1 |
| 129 | | | | |
| 130 | 179051-001 | 23 | TEST POINT | TP3,+5V1,+5V2,-5V1, BLU.,GND1-9,GRN.,RED., +12V1,+15V1,-22V1, CSYNC.,DIAGN.,RESET., WD-DIS |
| 131 | | | | |
| 132 | 133041-001 | 6 | TRANS, 2N3904 | Q5,Q7,Q9,Q11-13 |
| 133 | 133040-001 | 3 | TRANS, 2N3906 | Q6,Q8,Q10 |
| 134 | 133042-001 | 2 | TRANS, 2N6044 | Q1,Q2 |
| 135 | | | | |
| 136 | 144000-011 | 1 | XTAL, 3.6864, STANDUP | XTAL1 |
| 137 | 144008-003 | 1 | XTAL, 48 MHZ, OSCILLATOR MODULE | XOSC2 |
| 138 | | | | |

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| Title / ASSY, H.D. COMPACT MULTISYNC PCB | | P/L A046901-01 | Rev / C |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: | Page 1 of 1 |



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|--------------------------------|------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: <i>[Signature]</i> | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: <i>J. Mangolin</i> | Mfg. Eng: |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|----------------------------------|---------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | PER ECN 13506 <i>[Signature]</i> | | | | | | |
| C | PER ECN 13516 <i>[Signature]</i> | 5-19-82 | STW | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|---|-------------------|
| 1 | A044998-01 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 2 | IC, 34010-50 | 150S-GSP, 55L-MSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | 136068-2101 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136068-2102 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | 136068-2103 | 1 | IC, EPROM, 137448-200 | 210S |
| 19 | 136068-2104 | 1 | IC, EPROM, 137448-200 | 200S |
| 20 | | | | |
| 21 | 136068-1111 | 1 | IC, EPROM, 137448-200 | 210W |
| 22 | 136068-1112 | 1 | IC, EPROM, 137448-200 | 200W |
| 23 | | | | |
| 24 | | | | |
| 25 | | | | |
| 26 | 136068-1113 | 1 | IC, EPROM, 137448-200 | 210X |
| 27 | 136068-1114 | 1 | IC, EPROM, 137448-200 | 200X |
| 28 | | | | |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | SPEED, BCLK, VCLK |

| | | |
|-----------------------------|-----------------------------------|-------------|
| Title / ASSY. MULTISYNC PCB | P/L A046901-07 | Rev /A |
| GAMES ENGINEERING | PROJECT: R.D. PANORAMA N. AMERICA | |
| PARTS LIST SPECIFICATION | | Page 1 of 1 |



| | |
|--------------------------------------|-------------------------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: <i>LB Fitch</i> 4-1-91 | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: <i>J. Margolin</i> 4-1-91 | Mfg. Eng: <i>[Signature]</i> 4-1-91 |
| Ind. Design: | Dual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|--------|-----------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | 4-1-91 | <i>gm</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|--------------------------------|-------------------|
| 1 | A044998-02 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | 137412-115 | 1 | IC, SLAPSTIC | 200K |
| | COMMENT | | 137412-117, AS SUB FOR ITEM 11 | |
| 12 | | | | |
| 13 | 136088-2001 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136088-2002 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | 136088-2003 | 1 | IC, EPROM, 137448-200 | 210S |
| 16 | 136088-2004 | 1 | IC, EPROM, 137448-200 | 200S |
| 17 | 136088-2005 | 1 | IC, EPROM, 137448-200 | 210T |
| 18 | 136088-2006 | 1 | IC, EPROM, 137448-200 | 200T |
| 19 | 136088-2007 | 1 | IC, EPROM, 137448-200 | 210U |
| 20 | 136088-2008 | 1 | IC, EPROM, 137448-200 | 200U |
| 21 | 136088-2009 | 1 | IC, EPROM, 137448-200 | 210V |
| 22 | 136088-2010 | 1 | IC, EPROM, 137448-200 | 200V |
| 23 | 136088-2011 | 1 | IC, EPROM, 137448-200 | 210W |
| 24 | 136088-2012 | 1 | IC, EPROM, 137448-200 | 200W |
| 25 | 136088-2013 | 1 | IC, EPROM, 137448-200 | 210X |
| 26 | 136088-2014 | 1 | IC, EPROM, 137448-200 | 200X |
| 27 | 136088-2015 | 1 | IC, EPROM, 137448-200 | 210Y |
| 28 | 136088-2016 | 1 | IC, EPROM, 137448-200 | 200Y |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT | SPEED, BCLK, VCLK |
| | | | NOTE: PLACE RCPT FOR | |
| | | | SPEED ON 'B' | |
| | | | BCLK ON 'QB' | |
| | | | VCLK ON 'QB/2' | |

| | | | |
|---|--|--|-------------|
| TITLE / ASSY, MULTISYNC BOARD SET | | P/L A049345-01 | REV / C |
| COIN-OP ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: RACE DR. PANORAMA MODEL NO: NORTH AMERICAN | PAGE 1 OF 1 |



| | |
|-----------------------------|---------------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: L.FRITTS 4/1/91 | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: RMoncrief 4/1/91 | Mfg. Eng: Wrightnour 4/91 |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|---------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | PER ECN 14206 | 4/18/91 | | | | | |
| C | PER ECN 14247 | 5/7/91 | ED | | | | |

| ITEM | PART NO | QTY | DESCRIPTION |
|------|-------------|-----|---------------------------------------|
| 1 | A046901-07 | 1 | ASSY, MULTISYNC PCB |
| 2 | A047046-04 | 1 | ASSY, DRIVER ADSP II PCB |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | 178171-1616 | 3 | STANDOFF, 1/4 RND, #6-32 X 1, ALUM |
| 10 | 72-036S | 6 | WASHER, LOCK, EXT, #6, STEEL/ZINC |
| 11 | 72-1606F | 6 | SCREW, PAN, #6-32 X 3/8, X-REC, ZINC |
| 12 | 175014-1025 | 6 | WASHER, FLAT, .156 X .312, STEEL/ZINC |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | A047332-01 | 1 | ASSY, RIBBON CABLE, PCB |
| 17 | | | |

| | | | |
|---|--|------------------------------|-------------|
| Title / ASSY, H.D. COMPACT MULTISYNC PCB | | P/L A046901-02 | Rev /A |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: H.D. GERMAN VERSION | Page 1 of 1 |



| | |
|-------------------------------------|--------------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: <i>A. N. K. 6-16-89</i> | |
| Design Eng: <i>G. Mangin</i> | Comp. Eng: |
| Proj. Eng: | Mfg. Eng: <i>6-18-89</i> |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|---------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | 6-16-89 | jm | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|---|-------------------|
| 1 | A044998-01 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 2 | IC, 34010-50 | 150S-GSP, 55L-MSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | 136068-2201 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136068-2202 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | 136068-2203 | 1 | IC, EPROM, 137448-200 | 210S |
| 19 | 136068-2204 | 1 | IC, EPROM, 137448-200 | 200S |
| 20 | | | | |
| 21 | 136068-1111 | 1 | IC, EPROM, 137448-200 | 210W |
| 22 | 136068-1112 | 1 | IC, EPROM, 137448-200 | 200W |
| 23 | | | | |
| 24 | | | | |
| 25 | | | | |
| 26 | 136068-1113 | 1 | IC, EPROM, 137448-200 | 210X |
| 27 | 136068-1114 | 1 | IC, EPROM, 137448-200 | 200X |
| 28 | | | | |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | SPEED, BCLK, VCLK |

| | | | |
|--|--|------------------------------|--------|
| Title / ASSY, H.D. COMPACT MULTISYNC PCB | | P/L A046901-06 | Rev /D |
| GAMES ENGINEERING | | PROJECT: RACE DRIVIN, GERMAN | |
| PARIS LIST SPECIFICATION | | Page 1 of 1 | |



| | |
|-------------------------------|-----------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: A JACKSON 3-12-90 | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: J MARGOLIN 3-20-90 | Mfg. Eng: D W 3-29-90 |
| Ind. Design: | Dual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|-----------------------|------|------------------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | REVISED PER ECN 14009 | | | | | | |
| C | REVISED PER ECN 14155 | 1-91 | | | | | |
| D | REVISED PER ECN 14166 | 2-91 | <i>gm 2-7-91</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|--|-------------------|
| 1 | A044998-02 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | 137412-115 | 1 | IC, SLAPSTIC | 200K |
| 12 | COMMENT | | 137412-117 IS SUB. FOR 137412-115 | |
| 13 | 136078-5201 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136078-5202 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | 136078-5203 | 1 | IC, EPROM, 137448-200 | 210S |
| 16 | 136078-5204 | 1 | IC, EPROM, 137448-200 | 200S |
| 17 | 136078-5205 | 1 | IC, EPROM, 137448-200 | 210T |
| 18 | 136078-5206 | 1 | IC, EPROM, 137448-200 | 200T |
| 19 | 136078-4007 | 1 | IC, EPROM, 137448-200 | 210U |
| 20 | 136078-4008 | 1 | IC, EPROM, 137448-200 | 200U |
| 21 | 136078-4009 | 1 | IC, EPROM, 137448-200 | 210V |
| 22 | 136078-4010 | 1 | IC, EPROM, 137448-200 | 200V |
| 23 | 136078-1011 | 1 | IC, EPROM, 137448-200 | 210W |
| 24 | 136078-1012 | 1 | IC, EPROM, 137448-200 | 200W |
| 25 | 136078-1013 | 1 | IC, EPROM, 137448-200 | 210X |
| 26 | 136078-1014 | 1 | IC, EPROM, 137448-200 | 200X |
| 27 | 136078-4015 | 1 | IC, EPROM, 137448-200 | 210Y |
| 28 | 136078-4016 | 1 | IC, EPROM, 137448-200 | 200Y |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT | SPEED, BCLK, VCLK |
| | | | NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | |

| | | | |
|---------------------------------|--|-----------------------------------|--------|
| Title / ASSY, COMPACT MULTISYNC | | P/L A046901-04 | Rev /E |
| GAMES ENGINEERING | | PROJECT: RACE DRIVIN NO. AMERICAN | |
| PARTS LIST SPECIFICATION | | Page 1 of 1 | |



| | |
|-------------------------------|-----------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: A JACKSON 3-12-90 | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: J MARGOLIN 3-20-90 | Mfg. Eng: D W 3-29-90 |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|-----------------------|------|------------------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | REVISED PER ECN 14009 | | | | | | |
| C | REVISED PER ECN 14102 | 1126 | | | | | |
| D | REVISED PER ECN 14148 | 1-91 | | | | | |
| E | REVISED PER ECN 14164 | 2-91 | <i>jm 2-7-91</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|-----------------------------------|-------------------|
| 1 | A044998-02 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | 137412-115 | 1 | IC, SLAPSTIC | 200K |
| 12 | COMMENT | | 137412-117 IS SUB. FOR 137412-115 | |
| 13 | 136078-5001 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136078-5002 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | 136078-5003 | 1 | IC, EPROM, 137448-200 | 210S |
| 16 | 136078-5004 | 1 | IC, EPROM, 137448-200 | 200S |
| 17 | 136078-5005 | 1 | IC, EPROM, 137448-200 | 210T |
| 18 | 136078-5006 | 1 | IC, EPROM, 137448-200 | 200T |
| 19 | 136078-4007 | 1 | IC, EPROM, 137448-200 | 210U |
| 20 | 136078-4008 | 1 | IC, EPROM, 137448-200 | 200U |
| 21 | 136078-4009 | 1 | IC, EPROM, 137448-200 | 210V |
| 22 | 136078-4010 | 1 | IC, EPROM, 137448-200 | 200V |
| 23 | 136078-1011 | 1 | IC, EPROM, 137448-200 | 210W |
| 24 | 136078-1012 | 1 | IC, EPROM, 137448-200 | 200W |
| 25 | 136078-1013 | 1 | IC, EPROM, 137448-200 | 210X |
| 26 | 136078-1014 | 1 | IC, EPROM, 137448-200 | 200X |
| 27 | 136078-4015 | 1 | IC, EPROM, 137448-200 | 210Y |
| 28 | 136078-4016 | 1 | IC, EPROM, 137448-200 | 200Y |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT | SPEED, BCLK, VCLK |
| | | | NOTE: PLACE RCPT FOR | |
| | | | SPEED ON 'B' | |
| | | | BCLK ON 'QB' | |
| | | | VCLK ON 'QB/2' | |

| | | | |
|---|-------------------------------|----------------|-------------|
| Title / ASSY, H.D. COMPACT MULTISYNC PCB | | P/L A046901-03 | Rev /A |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | PROJECT: H.D. BRITISH VERSION | | Page 1 of 1 |



| | |
|---------------------------------------|---|
| Drawn by: STAFF | Next Assy: |
| Checked by: <i>G. Jackson 6-16-89</i> | |
| Design Eng: <i>J. Morgan</i> | Comp. Eng: |
| Proj. Eng: | Mfg. Eng: <i>Shawell - Design 6-19-89</i> |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|----------------|-----------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | <i>6-16-89</i> | <i>JM</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|---|-------------------|
| 1 | A044998-01 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 2 | IC, 34010-50 | 150S-GSP, 55L-MSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | 136068-2101 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136068-2102 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | 136068-2103 | 1 | IC, EPROM, 137448-200 | 210S |
| 19 | 136068-2104 | 1 | IC, EPROM, 137448-200 | 200S |
| 20 | | | | |
| 21 | 136068-2911 | 1 | IC, EPROM, 137448-200 | 210W |
| 22 | 136068-2912 | 1 | IC, EPROM, 137448-200 | 200W |
| 23 | | | | |
| 24 | | | | |
| 25 | | | | |
| 26 | 136068-2913 | 1 | IC, EPROM, 137448-200 | 210X |
| 27 | 136068-2914 | 1 | IC, EPROM, 137448-200 | 200X |
| 28 | | | | |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | SPEED, BCLK, VCLK |

| | | | |
|-------------------------------------|--|------------------------------|--------|
| Title / ASSY. COMPACT MULTISYNC PCB | | P/L A046901-05 | Rev /D |
| GAMES ENGINEERING | | PROJECT: RACE DRIVIN BRITISH | |
| PARTS LIST SPECIFICATION | | Page 1 of 1 | |



| | |
|-------------------------------|-----------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: A JACKSON 3-12-90 | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: J MARGOLIN 3-20-90 | Mfg. Eng: D W 3-29-90 |
| Ind. Design: | Dual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|-----------------------|------|------------------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | REVISED PER ECN 14009 | | | | | | |
| C | REVISED PER ECN 14147 | 1-91 | | | | | |
| D | REVISED PER ECN 14165 | 2-91 | <i>Jm 2-7-91</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|--|-------------------|
| 1 | A044998-02 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137543-001 | 1 | IC, 68681 | 200A |
| 9 | 136068-1168 | 1 | IC, PROM, 82S123 | 195U |
| 10 | | | | |
| 11 | 137412-115 | 1 | IC, SLAPSTIC | 200K |
| 12 | COMMENT | | 137412-117 IS SUB. FOR 137412-115 | |
| 13 | 136078-5001 | 1 | IC, EPROM, 137448-200 | 210R |
| 14 | 136078-5002 | 1 | IC, EPROM, 137448-200 | 200R |
| 15 | 136078-5003 | 1 | IC, EPROM, 137448-200 | 210S |
| 16 | 136078-5004 | 1 | IC, EPROM, 137448-200 | 200S |
| 17 | 136078-5005 | 1 | IC, EPROM, 137448-200 | 210T |
| 18 | 136078-5006 | 1 | IC, EPROM, 137448-200 | 200T |
| 19 | 136078-4007 | 1 | IC, EPROM, 137448-200 | 210U |
| 20 | 136078-4008 | 1 | IC, EPROM, 137448-200 | 200U |
| 21 | 136078-4009 | 1 | IC, EPROM, 137448-200 | 210V |
| 22 | 136078-4010 | 1 | IC, EPROM, 137448-200 | 200V |
| 23 | 136078-1111 | 1 | IC, EPROM, 137448-200 | 210W |
| 24 | 136078-1112 | 1 | IC, EPROM, 137448-200 | 200W |
| 25 | 136078-1013 | 1 | IC, EPROM, 137448-200 | 210X |
| 26 | 136078-1014 | 1 | IC, EPROM, 137448-200 | 200X |
| 27 | 136078-4015 | 1 | IC, EPROM, 137448-200 | 210Y |
| 28 | 136078-4016 | 1 | IC, EPROM, 137448-200 | 200Y |
| 29 | 179178-002 | 3 | CONN, RCPT, 2 CKT | SPEED, BCLK, VCLK |
| | | | NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | |

| | | | |
|---|-------------------------------|----------------|-------------|
| Title / ASSY, STUN RUNNER MULTISYNC PCB | | P/L A046901-51 | Rev /C |
| GAMES ENGINEERING PARTS LIST SPECIFICATION | PROJECT: STUN RUNNER(IRELAND) | | Page 1 of 1 |



| | |
|-------------------------|-------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: A.J. | |
| Design Eng: J. Margolin | Comp. Eng: |
| Proj. Eng: Ed Reddy | Mfg. Eng: 9-22-89 |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|---------|------|-----|-------------|------|------|
| C | PRODUCTION RELEASE | 9-21-89 | JM | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|--|-------------------|
| 1 | A044998-11 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP, |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | | | | |
| 6 | 137442-150 | 2 | IC, 48Z02-15, RAM | 200E, 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137412-117 | 1 | IC, SLAPSTIC | 200K |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | 136070-2101 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210R |
| 14 | 136070-2102 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200R |
| 15 | 136070-2003 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 210S |
| 16 | 136070-2004 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 200S |
| 17 | 136070-2005 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 210T |
| 18 | 136070-2006 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 200T |
| 19 | 136070-2107 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210U |
| 20 | 136070-2108 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200U |
| 21 | 136070-2109 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210V |
| 22 | 136070-2110 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200V |
| 23 | 136070-2111 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 210W |
| 24 | 136070-2112 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 200W |
| 25 | | | | |
| 26 | | | | |
| 27 | | | | |
| 28 | | | | |
| 29 | 179178-002 | 4 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'A' 'B' BCLK ON 'QB' VCLK ON 'QB/2' NOTE: 1. SEE ASSEMBLY DRAWING A044998-11 | SPEED, BCLK, VCLK |

| | | | |
|---|--|----------------------|--------|
| Title / ASSY, STUN RUNNER MULTISYNC PCB | | P/L A046901-11 | Rev /D |
| GAMES ENGINEERING | | PROJECT: STUN RUNNER | |
| PARTS LIST SPECIFICATION | | Page 1 of 1 | |



| | |
|------------------------|---------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: A.J. | |
| Design Eng: J MARGOLIN | Comp. Eng: |
| Proj. Eng: E ROTBERG | Mfg. Eng: D W |
| Ind. Design: | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|-----------------------------|---------|---------------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | | | | | |
| B | REV PER ECN 13566 | | | | | | |
| C | REV PER ECN 13641 | | | | | | |
| D | REV PER ECN 13676 <i>af</i> | 12-5-89 | <i>gm tkr</i> | | | | |

| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|---|-------------------|
| 1 | A044998-11 | 1 | ASSY, SUB, MULTISYNC PCB | |
| 2 | | | | |
| 3 | 137538-002 | 1 | IC, 34010-50 | 150S-GSP, |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | | | | |
| 6 | 137442-150 | 2 | IC, 48Z02-15, RAM | 200E, 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137412-117 | 1 | IC, SLAPSTIC | 200K |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | 136070-2101 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210R |
| 14 | 136070-2102 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200R |
| 15 | 136070-2103 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 210S |
| 16 | 136070-2104 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 200S |
| 17 | 136070-2105 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 210T |
| 18 | 136070-2106 | 1 | IC, EPROM, 27C512, 200NS, 137448-200 | 200T |
| 19 | 136070-2107 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210U |
| 20 | 136070-2108 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200U |
| 21 | 136070-2109 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210V |
| 22 | 136070-2110 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200V |
| 23 | 136070-2111 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 210W |
| 24 | 136070-2112 | 1 | IC, OTP, 27C512, 200NS, 137454-200 | 200W |
| 25 | | | | |
| 26 | | | | |
| 27 | | | | |
| 28 | | | | |
| 29 | 179178-002 | 4 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'A' 'B' BCLK ON 'QB' VCLK ON 'QB/2' | SPEED, BCLK, VCLK |

| | | | |
|--|--|--|-------------|
| TITLE / PROGRAMMED MEMORY & LOGIC, MULTISYNC PCB | | P/L A046901-21P | REV / A |
| COIN-OP ENGINEERING PARTS LIST SPECIFICATION | | PROJECT: STEEL TALONS MODEL NO: 52300 | PAGE 1 OF 1 |



| | |
|--------------------------------------|-----------------------------|
| Drawn by: COMPONENTS ENG | Next Assy: |
| Checked by: J BELL <i>JS 9/24/91</i> | |
| Design Eng: | Comp. Eng: |
| Proj. Eng: <i>El Logg 9/20/91</i> | Mfg. Eng: <i>87 9-20-91</i> |
| Ind. Design: <i>9/20/91</i> | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|---------|-----------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | 9/19/91 | <i>EL</i> | | | | |

| ITEM | PART NO | QTY | DESCRIPTION | CHECKSUM | REV |
|------|-------------|-----|--|----------|-----|
| 1 | 136087-1001 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210R | 7E01 | A |
| 2 | 136087-1002 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200R | 9502 | A |
| 3 | 136087-1003 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210S | A903 | B |
| 4 | 136087-1004 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200S | E604 | B |
| 5 | 136087-1005 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210T | 5C05 | B |
| 6 | 136087-1006 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200T | 4106 | B |
| 7 | 136087-1007 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210U | 3C07 | B |
| 8 | 136087-1008 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200U | BE08 | B |
| 9 | 136087-1009 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210V | 1E09 | A |
| 10 | 136087-1010 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200V | D510 | A |
| 11 | 136087-1011 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210W | 8811 | A |
| 12 | 136087-1012 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200W | D712 | A |
| 13 | 136087-1013 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210X | 2A13 | A |
| 14 | 136087-1014 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200X | E614 | A |
| 15 | 136087-1015 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 210Y | 3E15 | A |
| 16 | 136087-1016 | 1 | IC, PR EPROM, STEEL TALONS, 137448-200, 200Y | 0816 | A |
| 17 | 136087-9001 | 1 | IC, PR FPLA, STEEL TALONS, 137684-035, 200K | 99FA | -A |

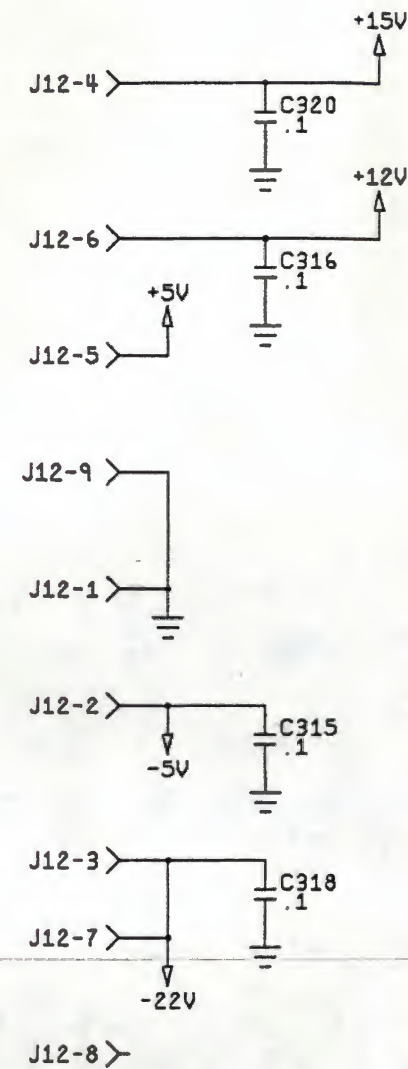
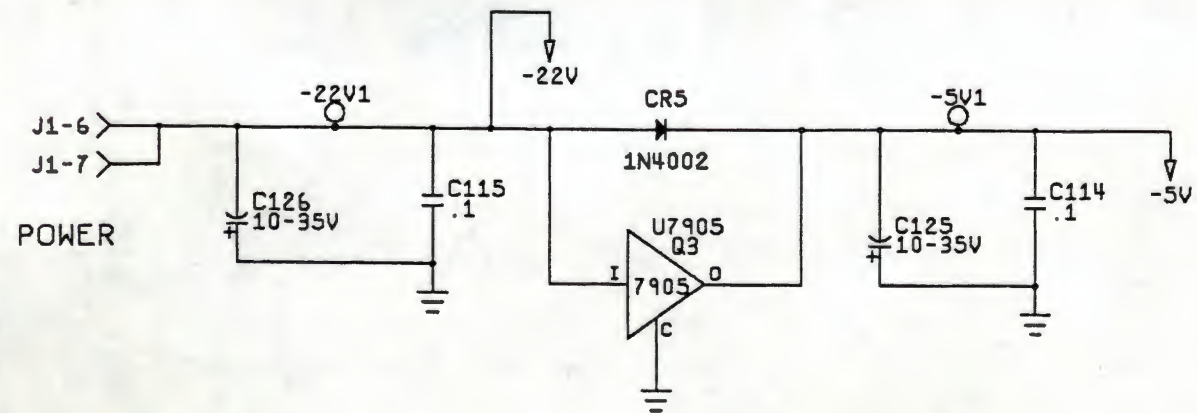
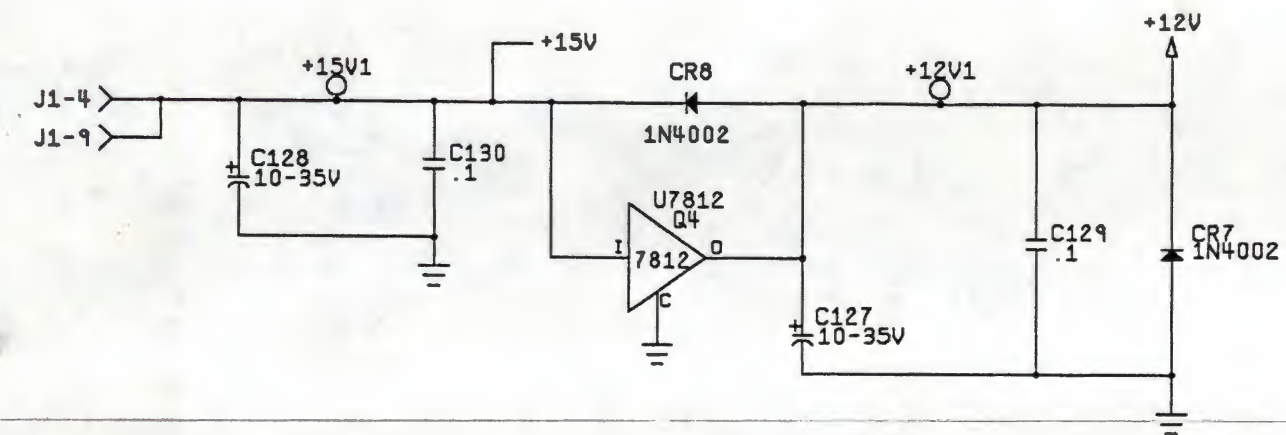
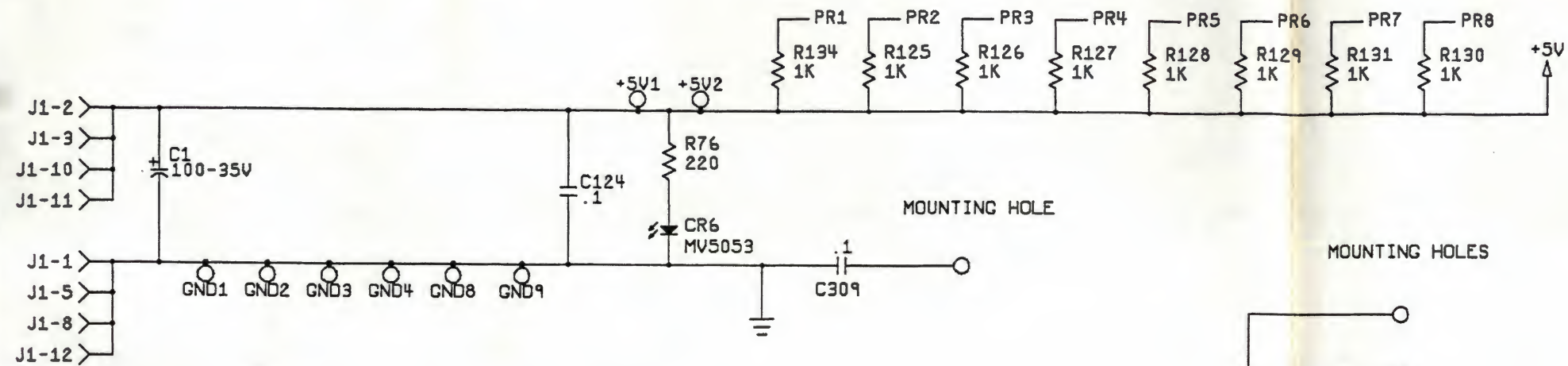
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|---|-----------------------|----------------|-------------|
| Title / ASSY, STEEL TALONS, MULTISYNC PCB | | P/L A046901-21 | Rev /B |
| GAMES ENGINEERING | PROJECT: STEEL TALONS | | Page 1 of 1 |
| PARTS LIST SPECIFICATION | | | |



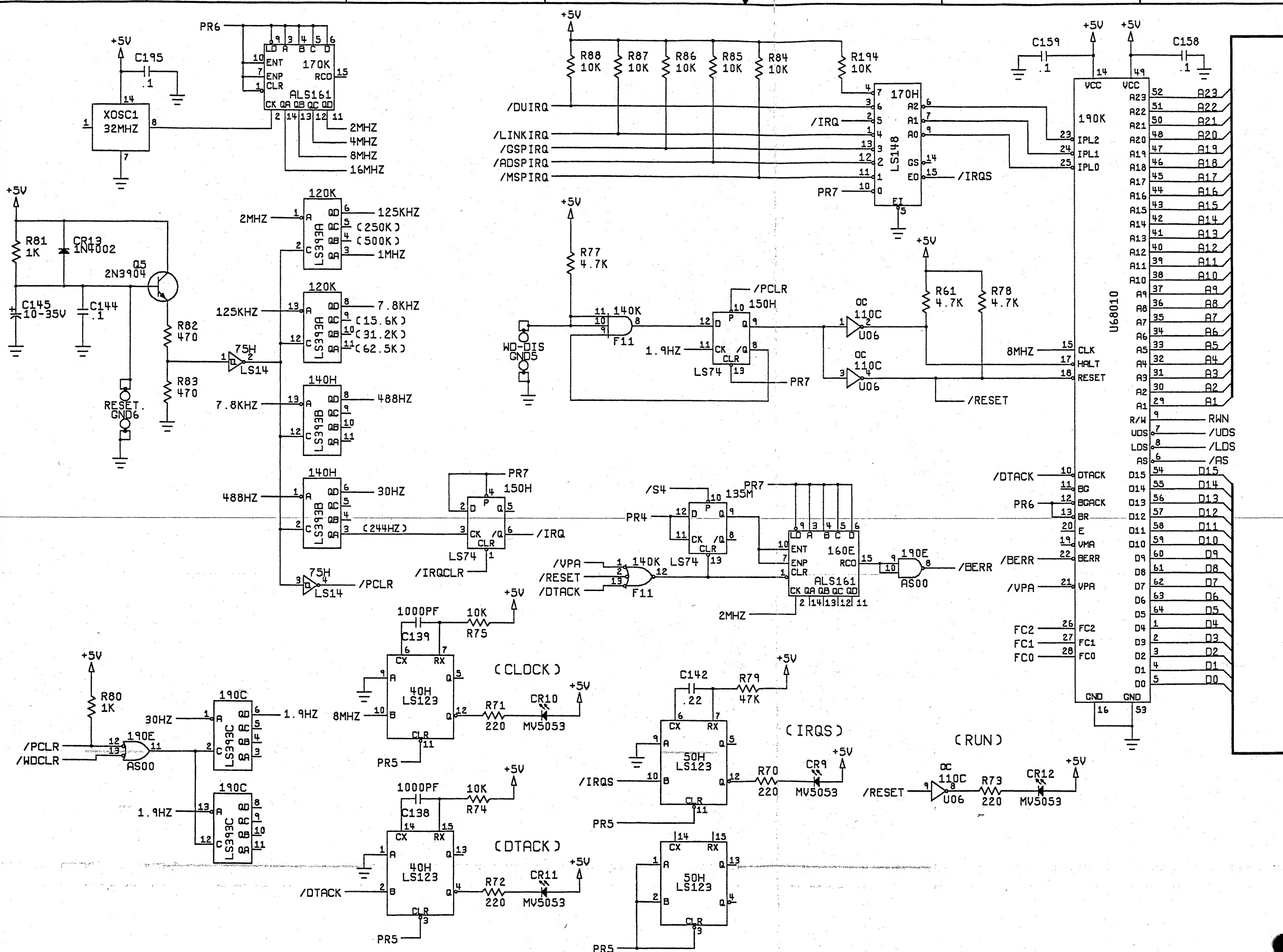
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|------------------------------|-----------------------|
| Drawn by: STAFF | Next Assy: |
| Checked by: FRITTS 6-3-91 | |
| Design Eng: MARGOLIN 6-17-91 | Comp. Eng: |
| Proj. Eng: Ed Lagg 10.7.91 | Mfg. Eng: D W 6-17-91 |
| Ind. Design: W | Qual. Eng: |

| REV | DESCRIPTION | DATE | APPR | REV | DESCRIPTION | DATE | APPR |
|-----|--------------------|------|------|-----|-------------|------|------|
| A | PRODUCTION RELEASE | | EL | | | | |
| B | REV PER ECN 14379 | | | | | | |

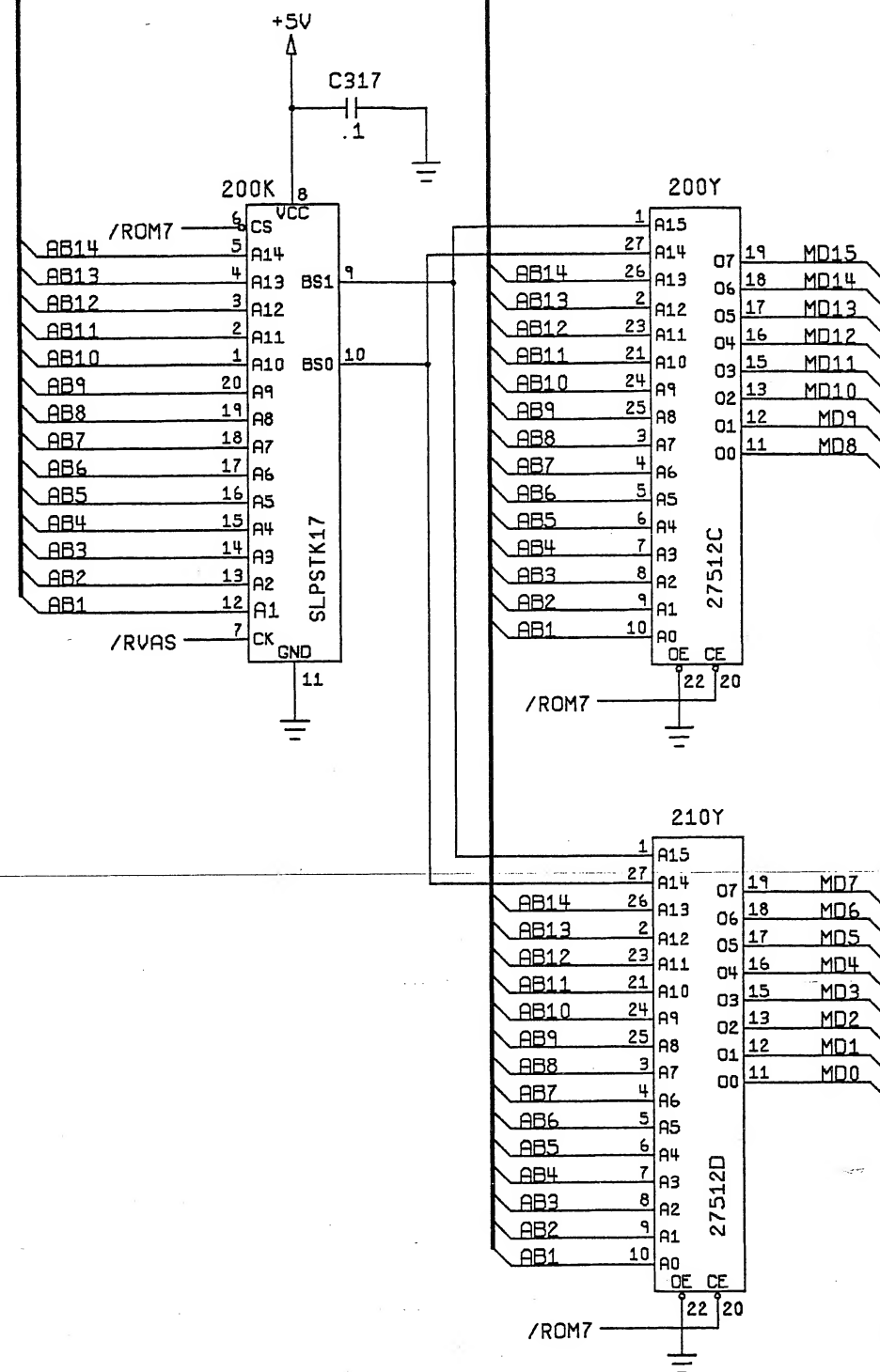
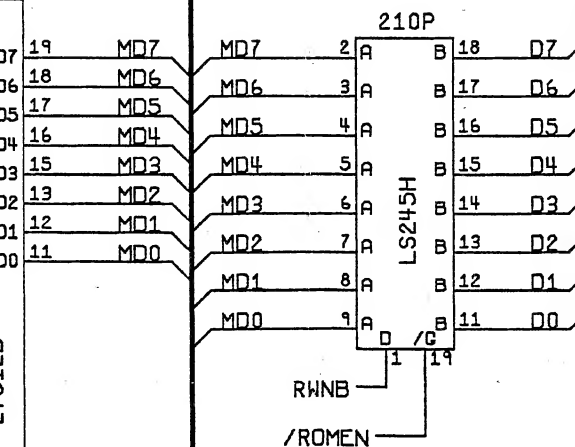
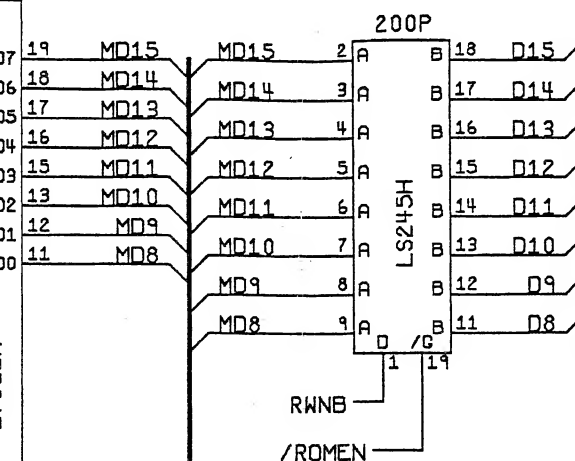
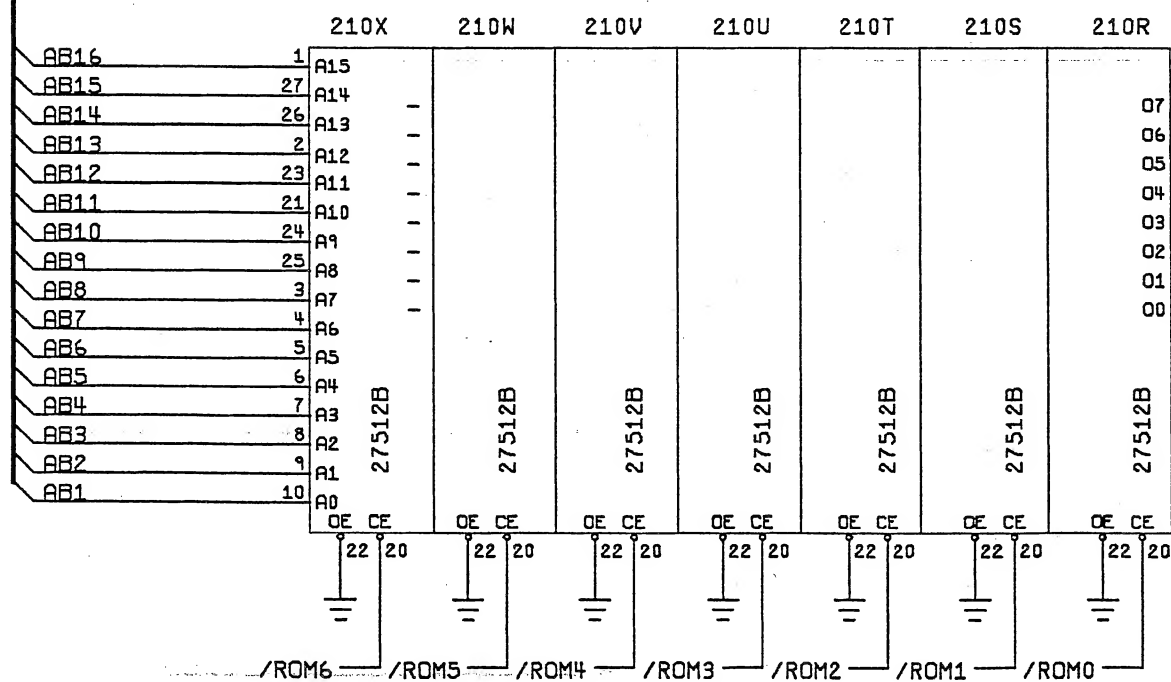
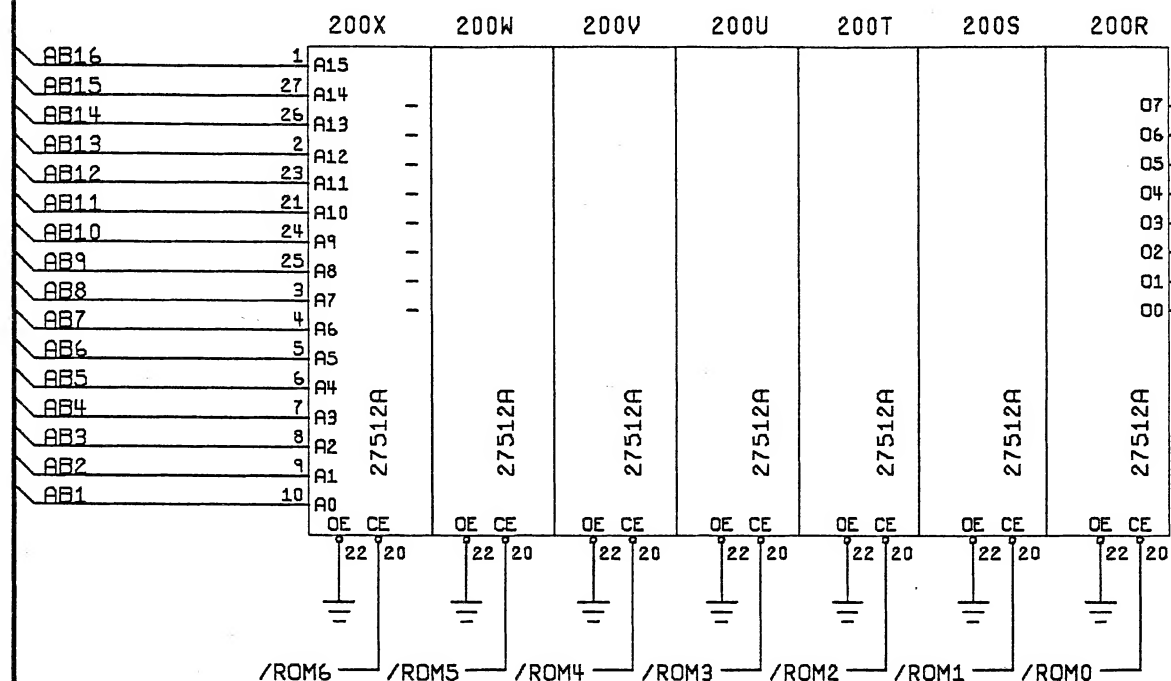
| ITEM | PART NO | QTY | Description | Ref. Designators |
|------|-------------|-----|---|-------------------|
| 1 | A044998-03 | 1 | ASSY, SUB, MULTISYNC | |
| 2 | A046901-21P | 1 | PROGRAMMED MEMORY AND LOGIC | |
| 3 | 137538-002 | 2 | IC, 34010-50 | 150S-GSP, 55L-MSP |
| 4 | 137559-001 | 1 | IC, 34012-50 | 120S-PSP |
| 5 | 137540-150 | 1 | IC, 48T02-15, RAM | 200E |
| 6 | 137442-150 | 1 | IC, 48Z02-15, RAM | 210E |
| 7 | 137414-002 | 1 | IC, 68010 | 190K |
| 8 | 137545-001 | 1 | IC, AD7582 | 30D |
| 9 | | | | |
| 10 | 179178-002 | 3 | CONN, RCPT, 2 CKT NOTE: PLACE RCPT FOR SPEED ON 'B' BCLK ON 'QB' VCLK ON 'QB/2' | SPEED, BCLK, VCLK |



SOUND



| | | |
|--|--------------------------|----------|
| ATARI | | |
| ATARI GAMES CORP. 675 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE SCHEMATIC MULTISYNC PCB | | |
| SIZE D | DRAWING NO. 044998-01 | REV F |
| SCALE NONE | SHEET 3 | OF 17 |

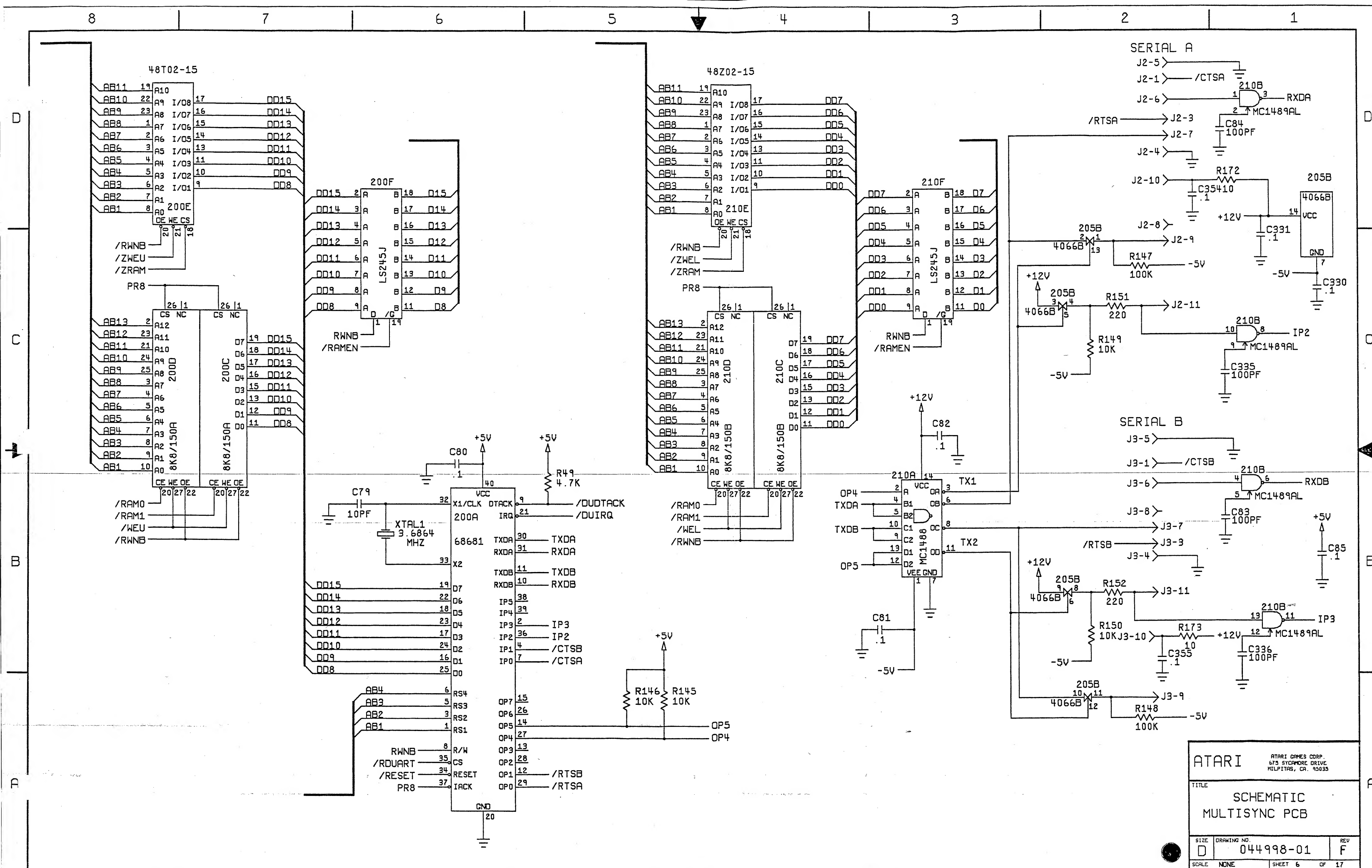


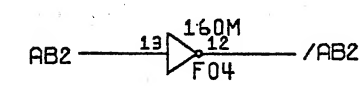
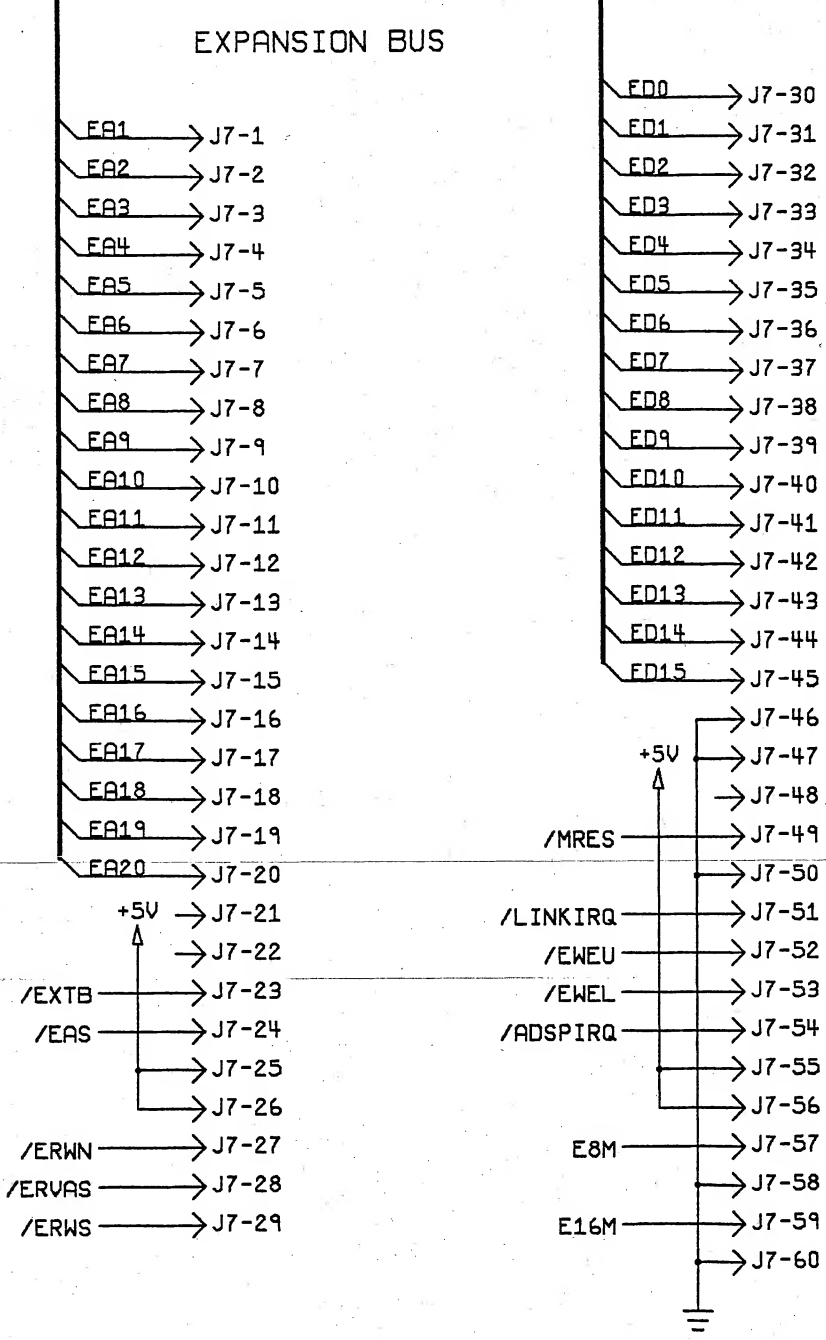
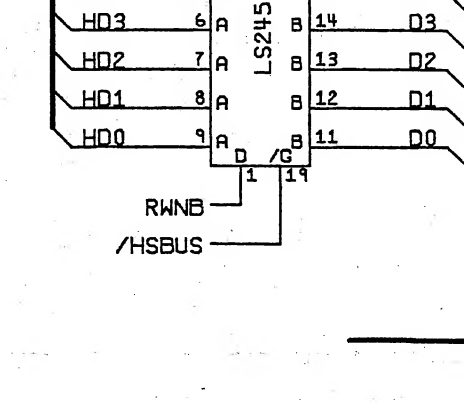
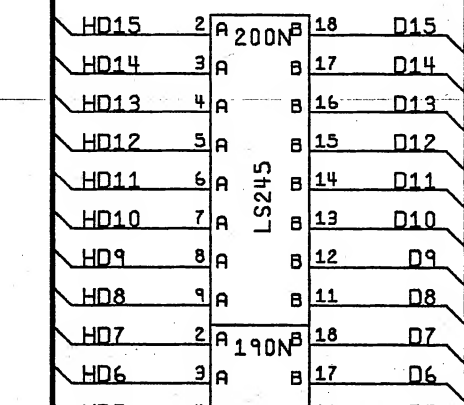
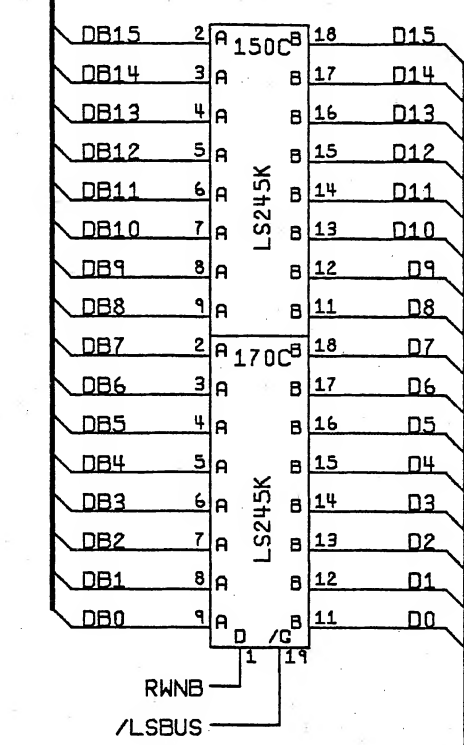
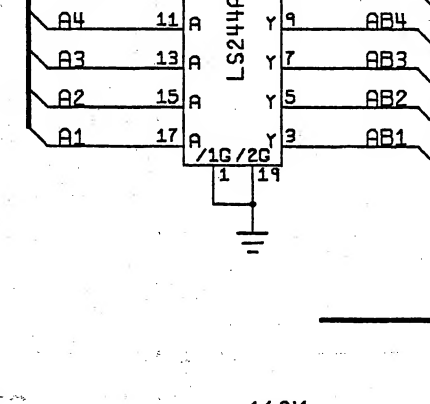
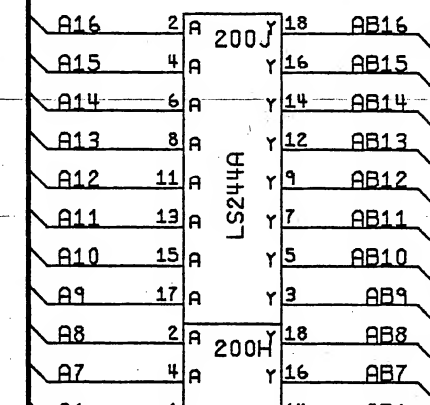
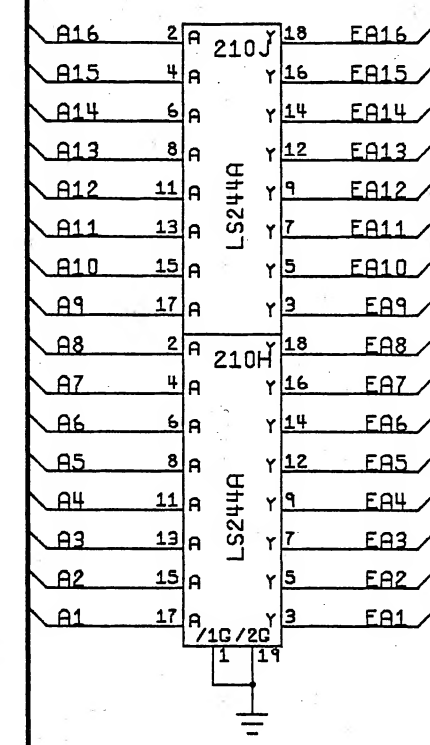
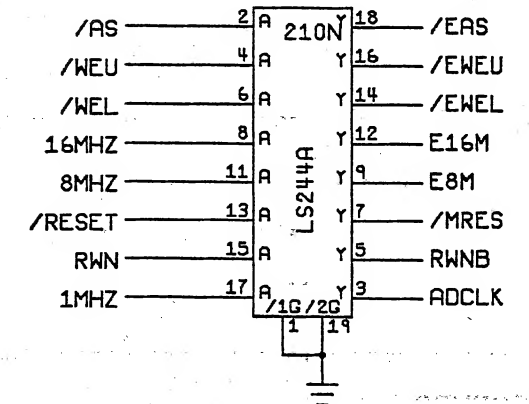
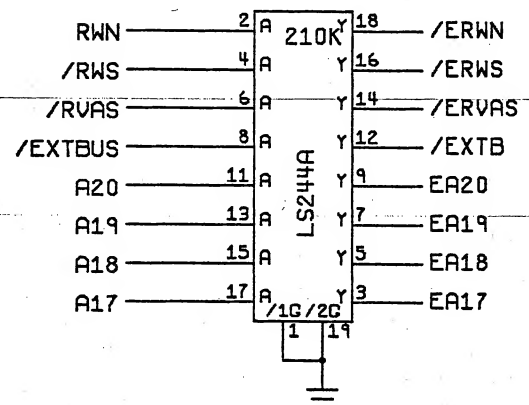
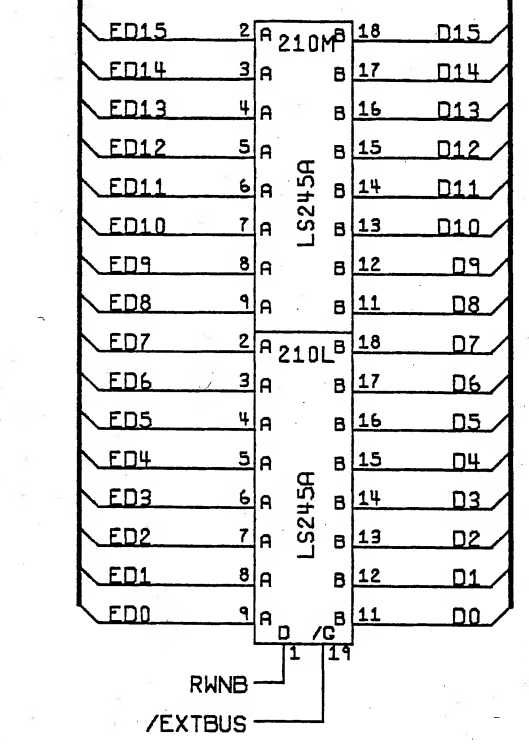
ATARI

ATARI GAMES CORP.
675 SICHARD DRIVE
MILPITAS, CA. 95035

TITLE
SCHEMATIC
MULTISYNC PCB

| | | |
|-------|-------------|---------------|
| SIZE | DRAWING NO. | REV |
| D | 044998-01 | F |
| SCALE | NONE | SHEET 5 OF 17 |





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|--|--------------------------|----------|
| ATARI | | |
| ATARI GAMES CORP. 675 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE SCHEMATIC MULTISYNC PCB | | |
| SIZE D | DRAWING NO. 044998-01 | REV F |
| SCALE NONE | SHEET 7 | OF 17 |

D

C

B

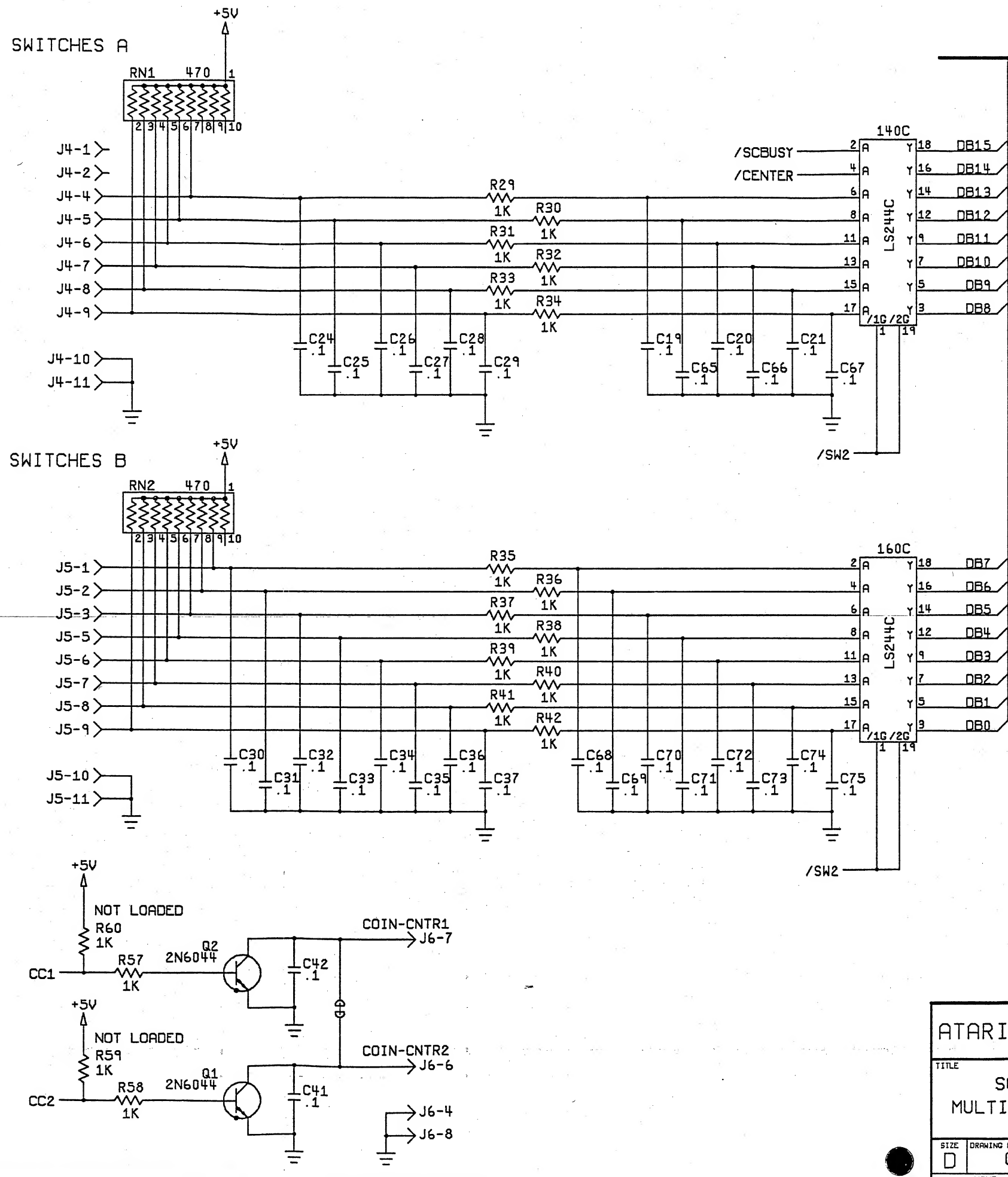
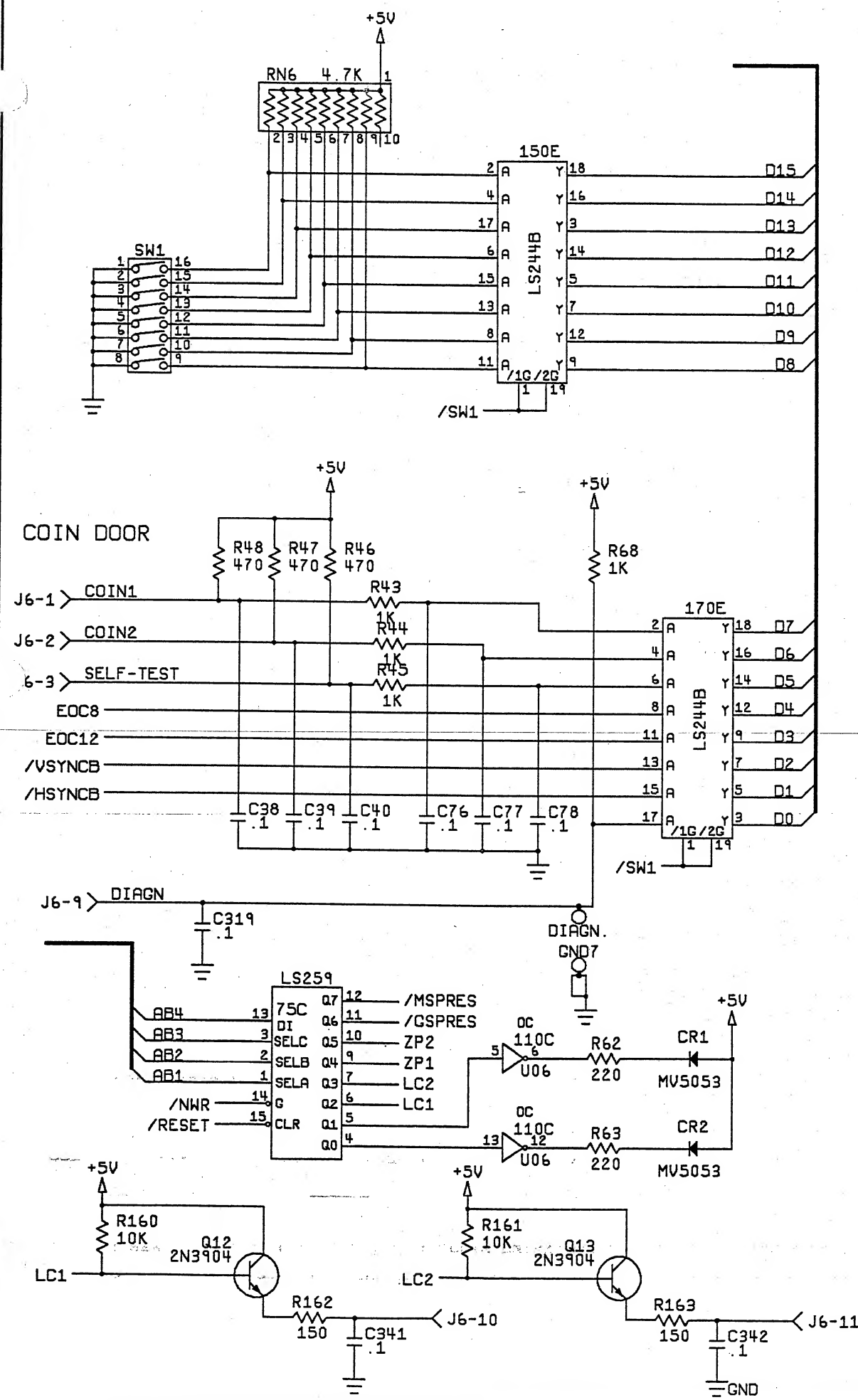
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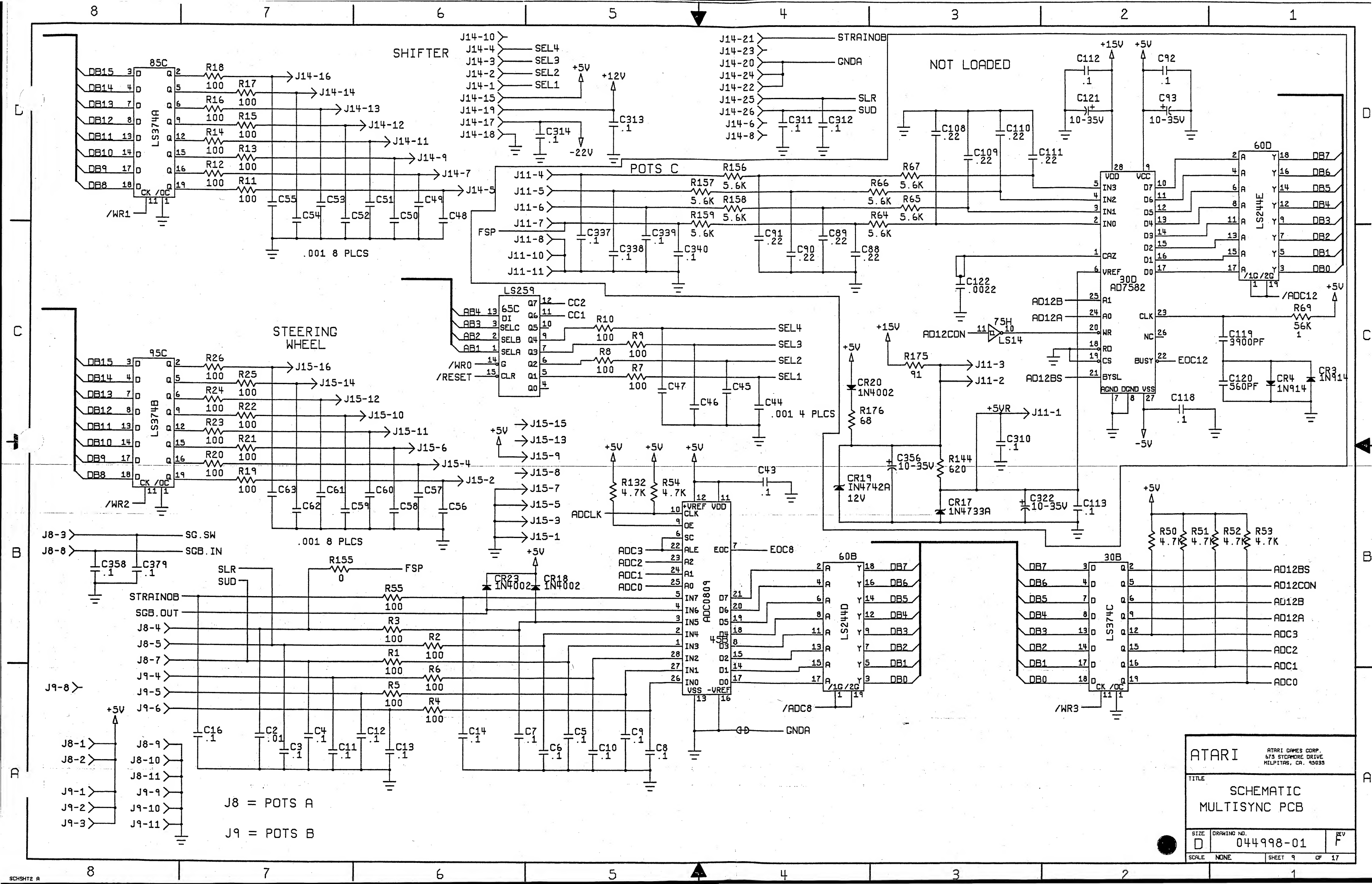
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B

A

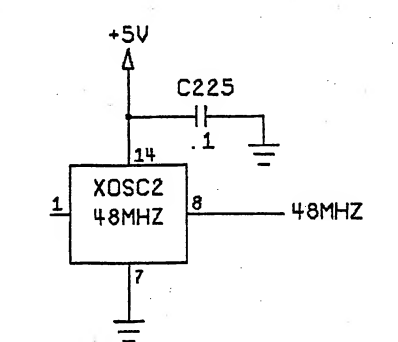
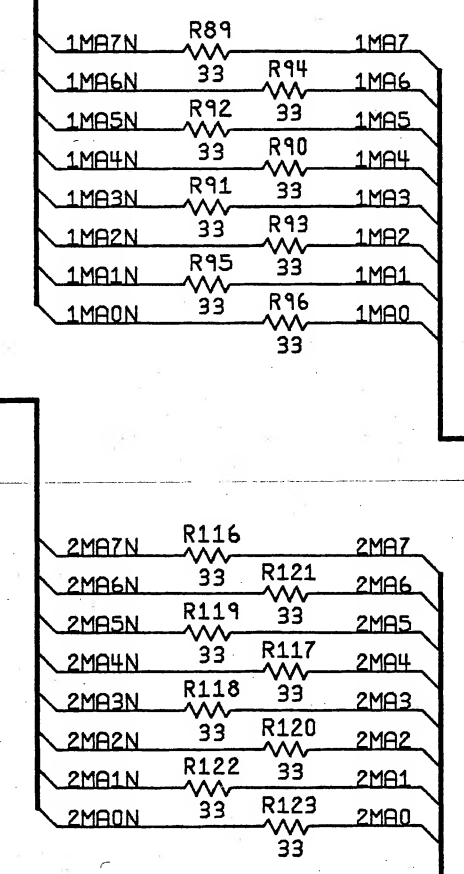
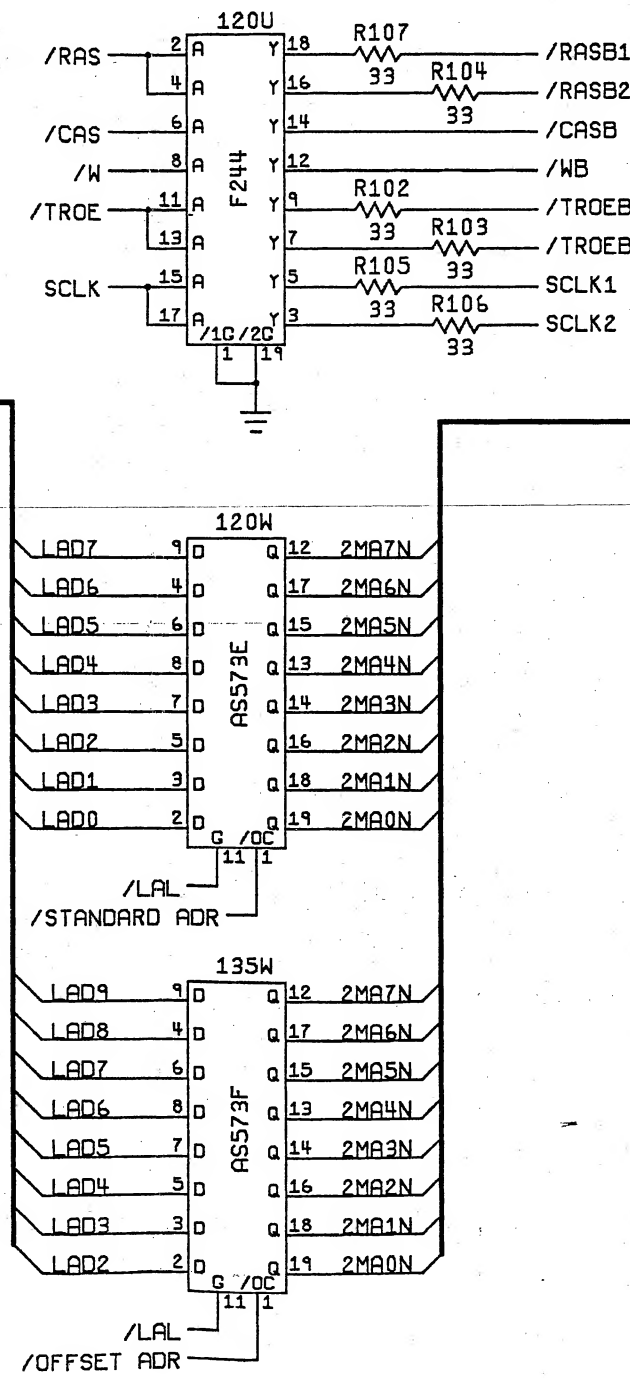
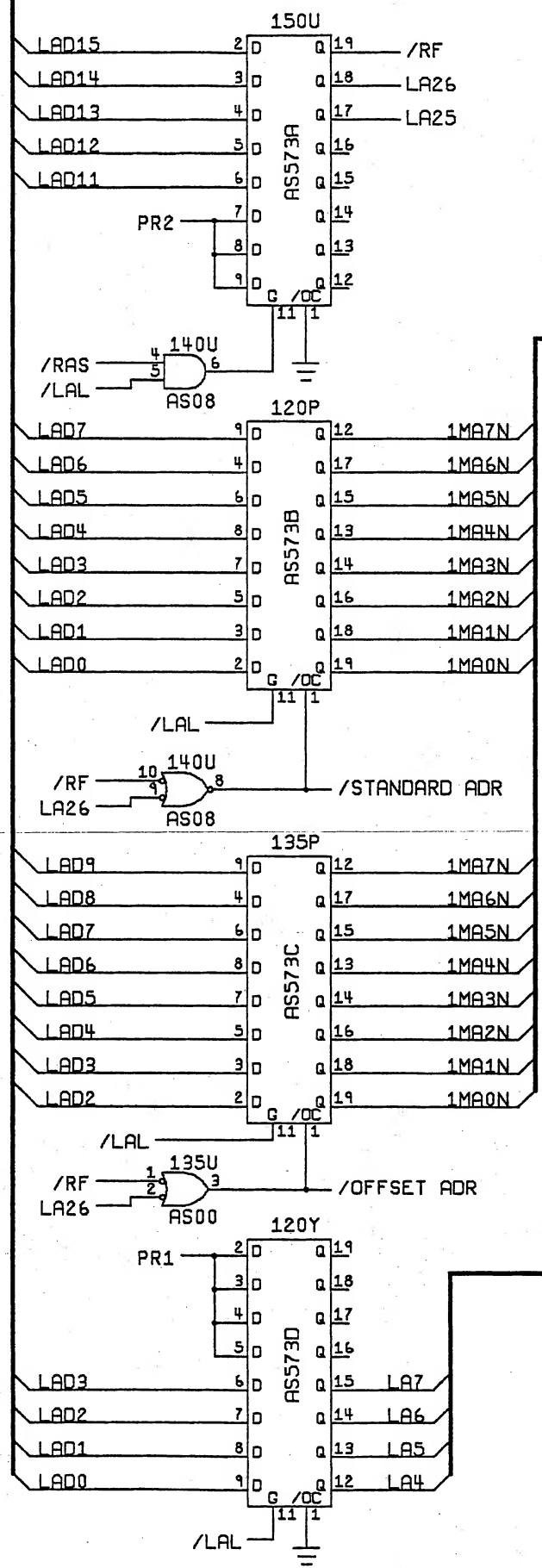
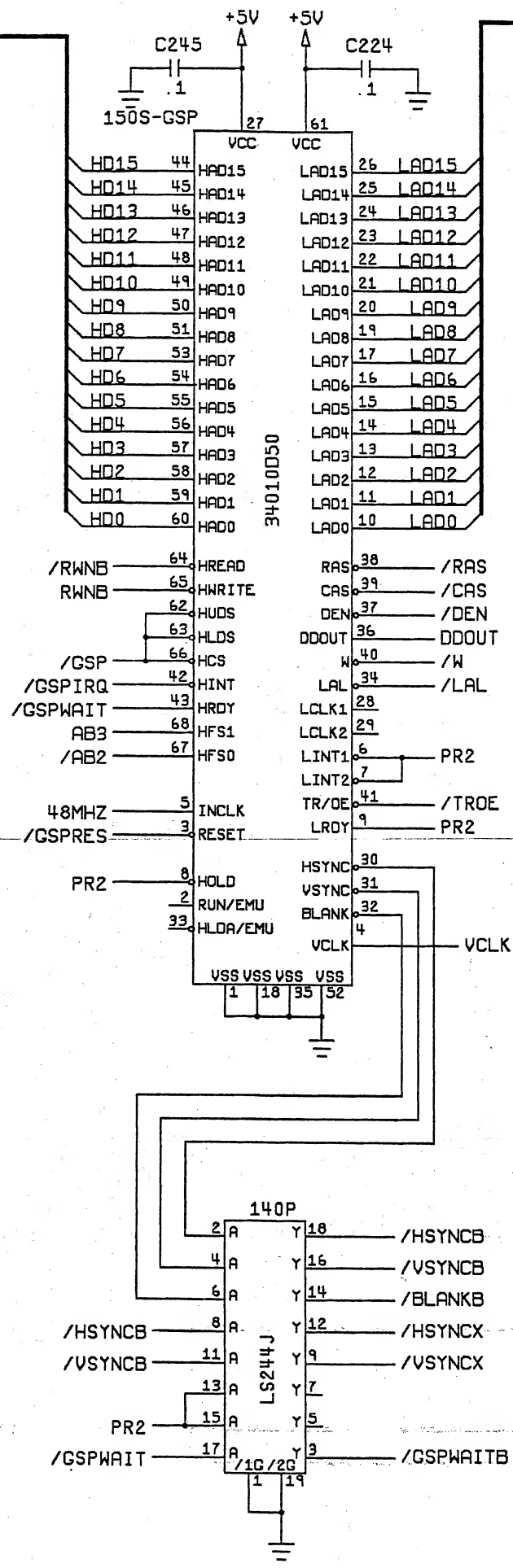




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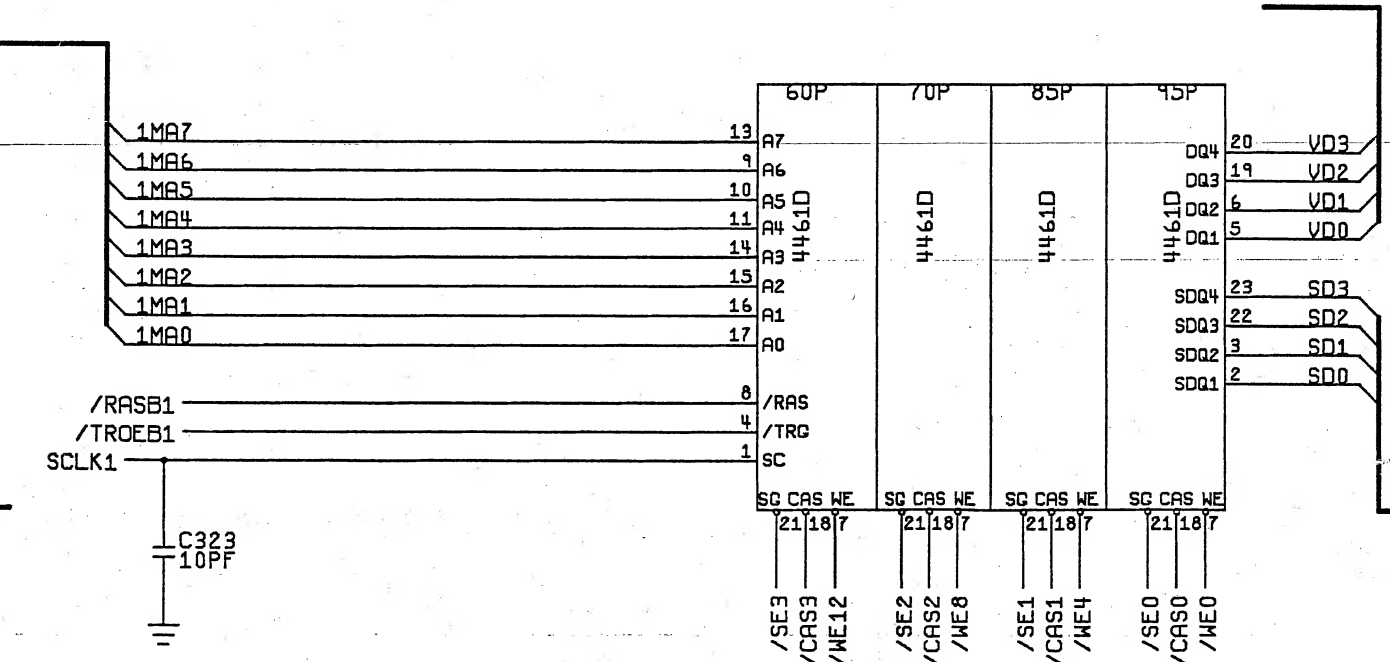
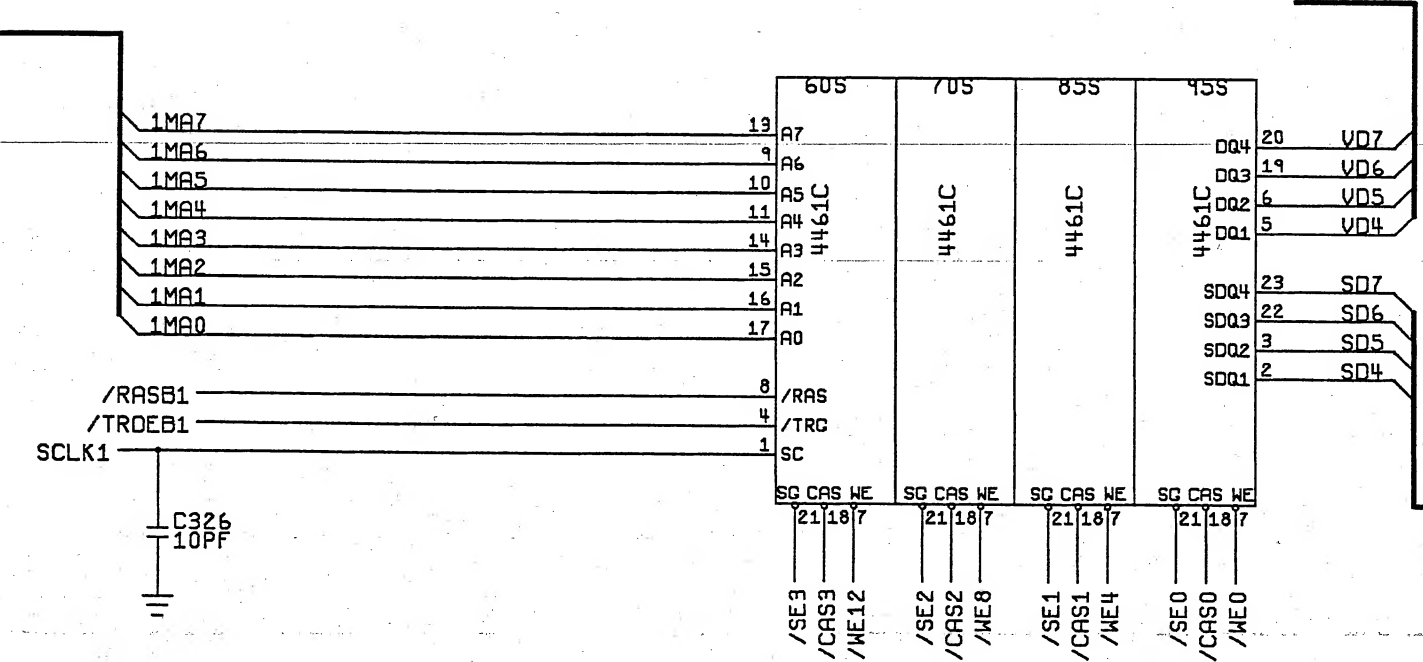
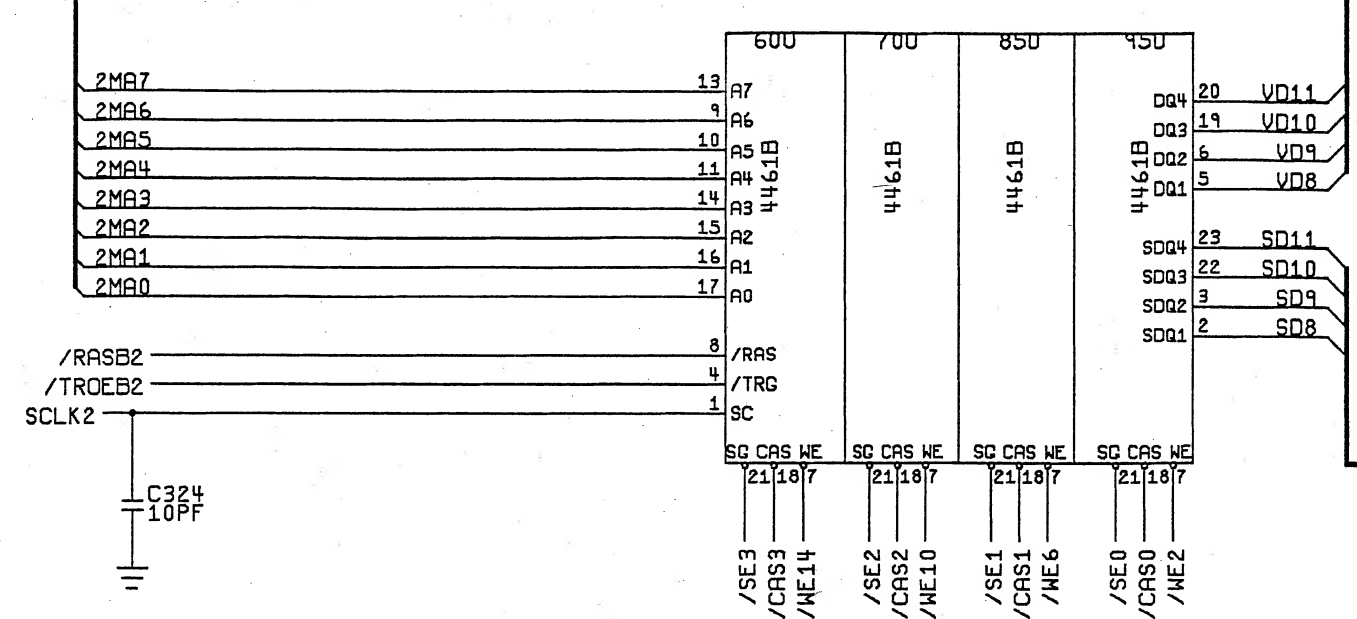
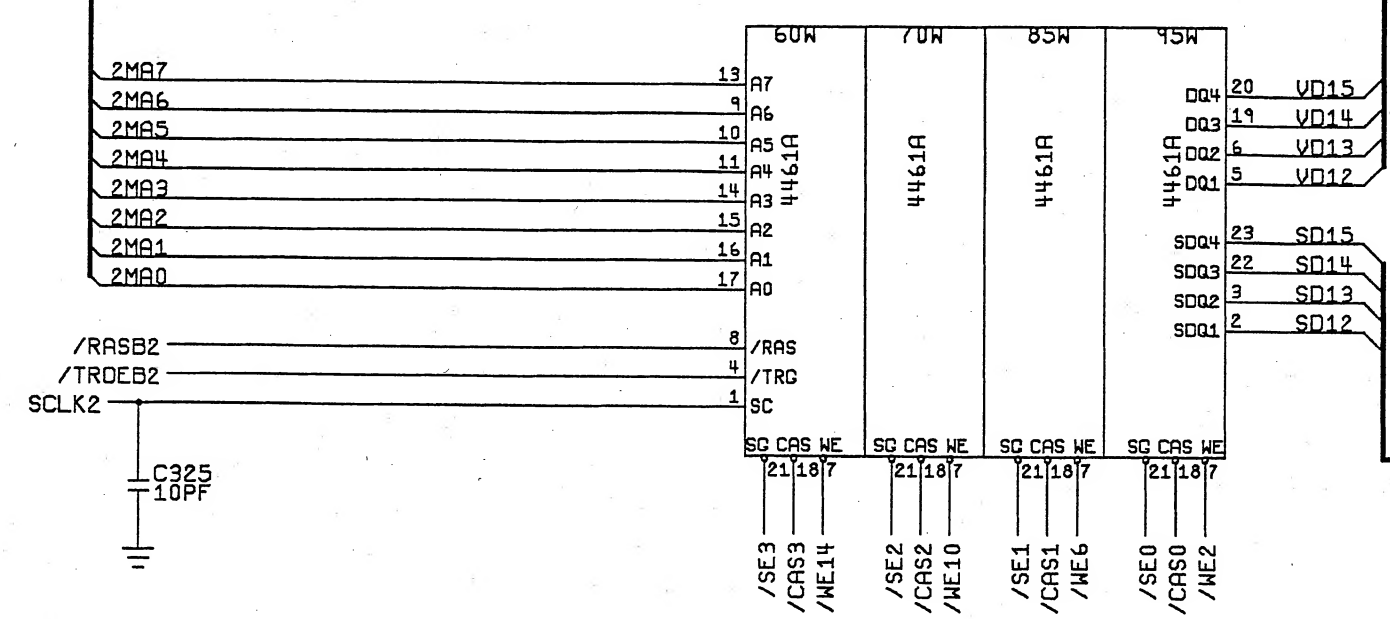
B

A

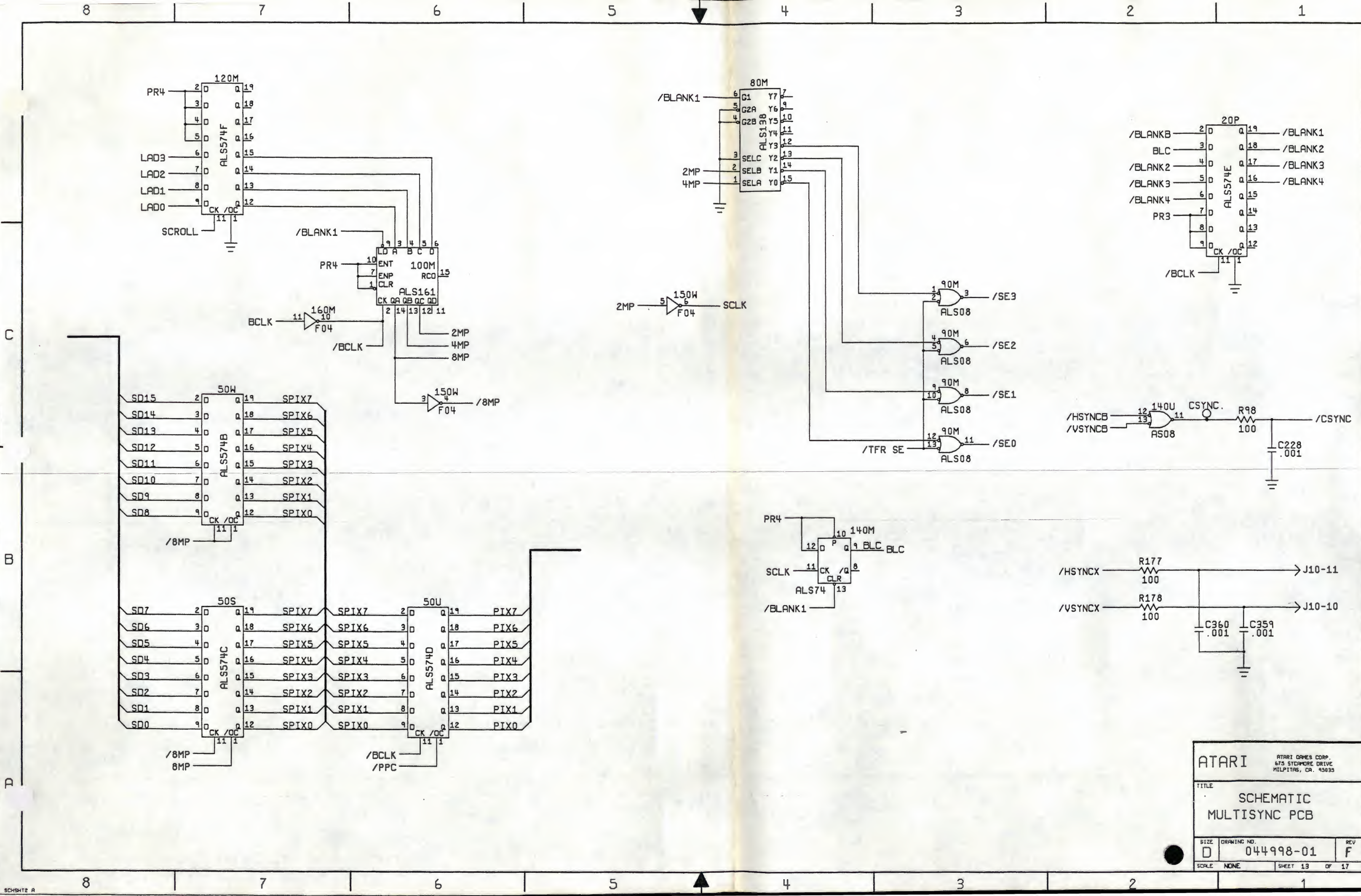


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|--|-------------|----------------|
| ATARI | | |
| ATARI GAMES CORP. 675 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE | | |
| SCHEMATIC | | |
| MULTISYNC PCB | | |
| SIZE | DRAWING NO. | REV |
| D | 044998-01 | F |
| SCALE | NONE | SHEET 10 OF 17 |

8 7 6 5 4 3 2 1



| | | |
|--|-------------|----------------|
| ATARI | | |
| ATARI GAMES CORP. 673 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE | | |
| SCHEMATIC MULTISYNC PCB | | |
| SIZE | DRAWING NO. | REV |
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| SCALE | NONE | SHEET 12 OF 17 |

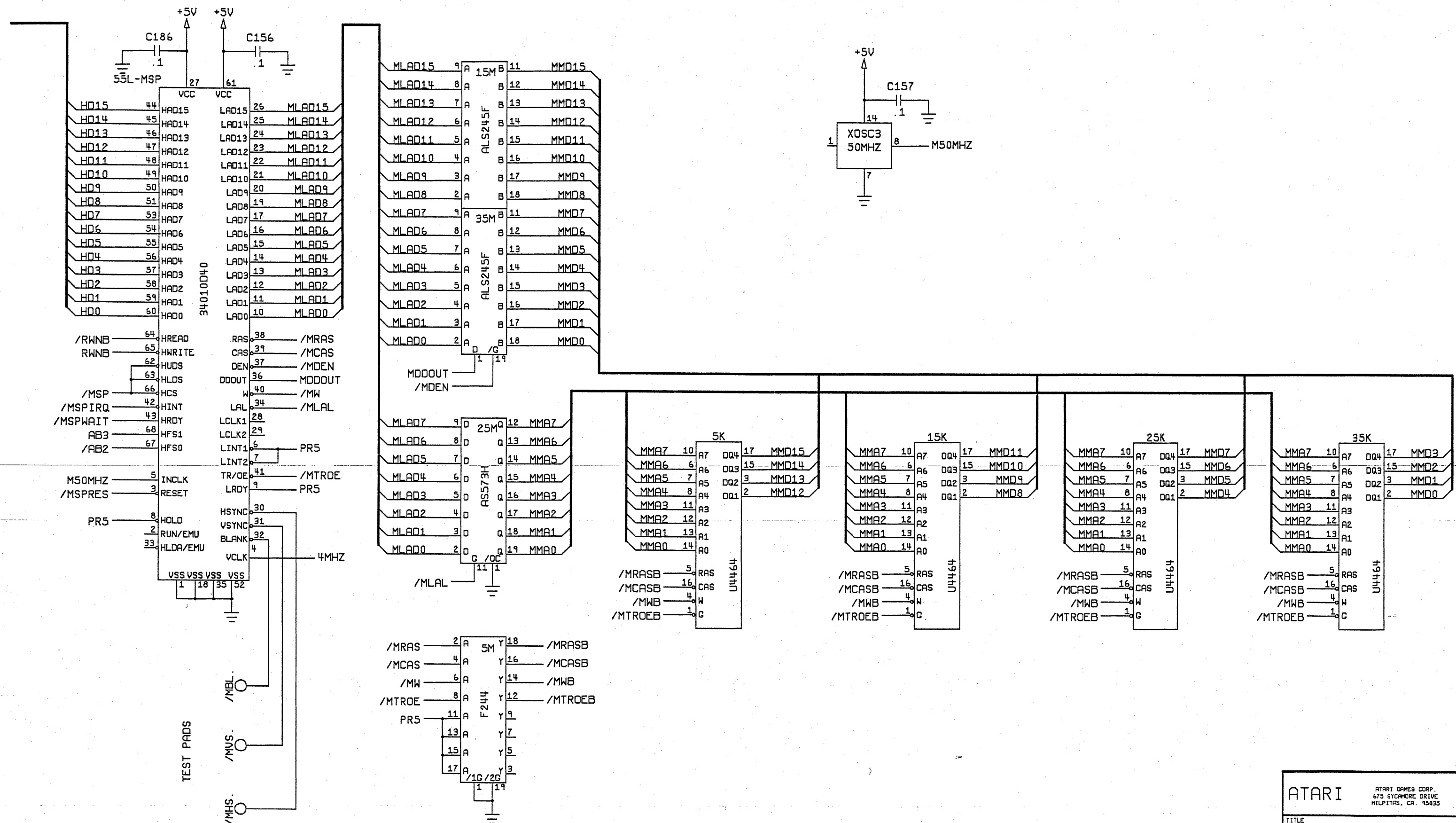


| | | |
|--|--------------------------|----------|
| ATARI | | |
| ATARI GAMES CORP. 675 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE SCHEMATIC MULTISYNC PCB | | |
| SIZE D | DRAWING NO. 044998-01 | REV F |
| SCALE NONE | SHEET 13 | OF 17 |

C

B

P



| | | |
|--|-------------|----------------|
| ATARI | | |
| ATARI GAMES CORP. 675 SYCAMORE DRIVE MILPITAS, CA. 95035 | | |
| TITLE | | |
| SCHEMATIC MULTISYNC PCB | | |
| SIZE | DRAWING NO. | REV |
| D | 044988-01 | F |
| SCALE | NONE | SHEET 15 OF 17 |

